American
GAS JOURNAL
Formerly American Gas Light Journal
EST. 1859

VOL. 120. No. 15.
WHOLE NO. 3487.

NEW YORK, SATURDAY, APRIL 12, 1924

Subscription $3 per year
$4 Canada $5 Foreign

The Catechism of Central Station Gas Engineering Has THIS to Say about the Properties of a GAS COAL

Properties of a Coal Gas Coal

11. What are the properties that must be possessed by a coal to fit it for being used for the manufacture of coal gas?

Ans. The most valuable coals for use in the manufacture of coal gas are those which contain a small percentage of ash and sulphur, a comparatively large percentage of volatile matter of good illuminating value, and which possess coking qualities that permit the production of good salable coke amounting to from 55 per cent to 65 per cent of the original weight of the coal.

A good Pittsburgh coal, which may be taken as the standard gas coal of the United States, will show the following analysis by weight:

Volatile Matter	33% to 35%
Fixed Carbon	60% to 55%
Ash	6% to 4%
Sulphur	0.4% to 0.6%

Compare that Analysis with THIS of our Tildesley Gas Coal

Analysis:

Moisture	1.29
Volatile Matter	34.55
Fixed Carbon	60.42
Ash	3.74
	100.00
Sulphur	.62
B.T.U. per Pound	14621
Fusion Point of Ash	2786 F.

Made by the Pittsburgh Testing Laboratory.

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THE TILDESLEY COAL CO.

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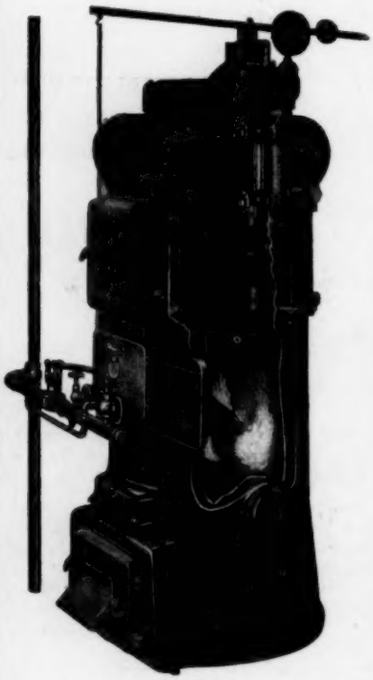

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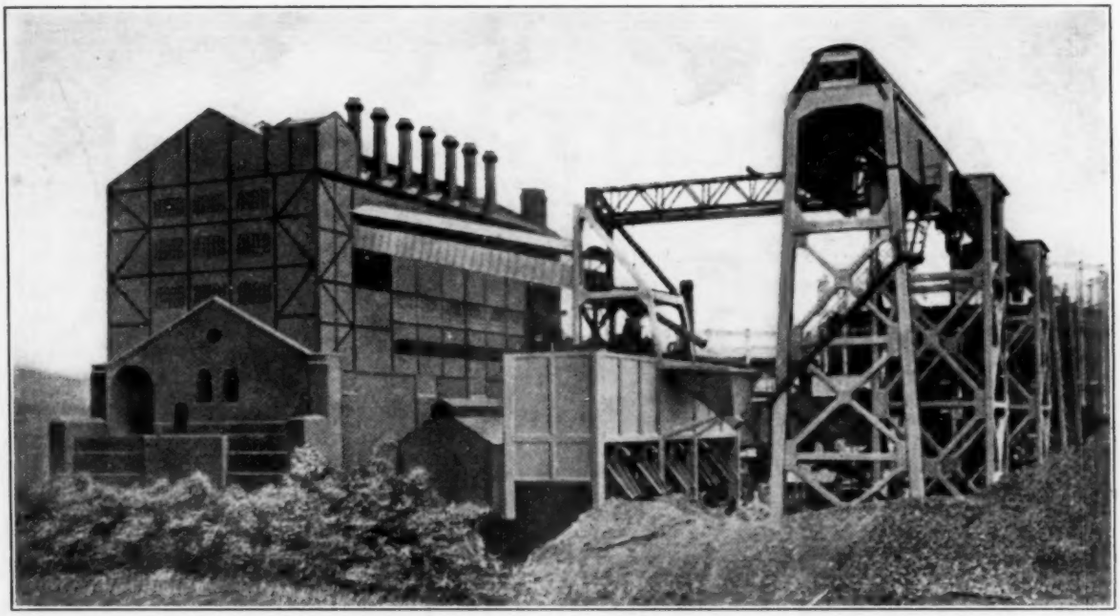

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American Gas Journal

SIXTY-FIFTH YEAR

Published Weekly by American Gas Light Journal, Inc., 53 Park Place, New York, N. Y.

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Subscription $3.00 per year, including postage, in the United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines; in Canada, $4.00; foreign, $5.00—Single Copies, 10 cents.

AMERICAN GAS JOURNAL, April 12, 1924. Vol. 120, No. 15.
Published weekly by American Gas Light Journal, Inc., New York, N. Y.
Entered as second-class matter Jan. 9, 1917, at the post-office at New York, N. Y., under the Act of March 3, 1879.

AMERICAN
GAS JOURNAL

Vol. 120. No. 15 NEW YORK, APRIL 12, 1924 Whole No. 3457

The Fuel of the Future. What Shall It Be?

IX. House Heating

The development of the general formula and the part played by ventilation

Ismar Ginsberg

IN THE previous articles on the subject of house heating, the economic features of the house heating business from the gas standpoint were discussed in detail. The fundamental basis, on which house heating business could be successfully and economically solicited by the gas company with the assurance of adequate return on its part and satisfactory service on the part of the customer, was also described. In the article directly prior to this one, the various methods in common usage today of heating houses were described.

House heating with gas does not involve the introduction of any new methods of keeping a building warm. It merely consists of the substitution of the gaseous fuel for the one now used, coal. It, of course, does not follow that the substitution of gas for coal can be accomplished without making some changes in the system, but this change will not be a fundamental one. It will not mean the tearing out of existing installations or the addition of complicated and expensive auxiliary apparatus. A few alterations will have to be made and an additional piece of apparatus, not of high cost, may have to be added. But this change will be to the better advantage of the customer, for it will make the installation more efficient than before and will mean a saving in the amount of gas consumed.

Old Installations Must Be Converted

It has been brought out in the previous articles that the gas man cannot develop his house heating business by advocating the removal of apparatus already installed on the premises and designed for burning other fuels besides gas. He will have to convert the existing furnace and heating system into one in which gas can be used as a fuel, even though greater efficiency might be obtained with a new furnace and an installation specially designed for burning gas. He can only insist upon the installation of the proper type of gas-burning furnace in new buildings which are to be heated with this fuel.

Therefore, he must use what is available and must understand the calculations that are involved in heating houses with these installations. These calculations are basic and can be applied as well to new heating systems in which gas is used as a fuel.

Heat Supplied and Required

There are a certain number of factors involved in determining how much of a fuel must be burnt in order to keep the rooms of a building warm during the cold months of the year. The first consideration is the temperature which is to be maintained within the building. There are certain standards that are used in this connection, depending on the nature of the building and the purpose for which it is used. A tabulation, showing the different temperatures usually maintained within buildings, follows:

Public buildings	68 to 72 deg. F.
Factories	65 deg F.
Machine shops	60 to 65 deg. F.
Foundries, boiler shops, etc.	50 to 60 deg. F.
Residences	70 deg. F.
Bath rooms	85 deg. F.
Schools	70 deg. F.
Hospitals	72 to 75 deg. F.
Paint shops	80 deg. F.

While these figures may vary according to local conditions, they are standard practice and are used in calculations to determine the amount of heat required to make the building comfortable to its occupants.

The heat that must be supplied to the building or the room must be sufficient to maintain the temperature of the room at the desired point and also to offset the losses of heat that constantly take place during the heating process. These heat losses are

of two kinds. First there is the loss of heat that is due to the transmission of the warm air inside the building or room to the cold air outside the building. The transmission of heat takes place through the walls, ceilings, roof or floor of the building or room. The loss of heat incurred in this manner is due to the difference between the inside and outside temperatures. It is evident that this depends both on the outside temperature and on the inside temperature that must be maintained within the building. It is also clear that the loss of heat caused by this phenomenon will vary directly as the temperature difference, although this variation will not be a simple one. The heat loss will increase rapidly with increase in the difference between the inside and outside temperatures.

Construction of Walls, Etc.

The loss of heat due to transmission through the containing walls, etc., is dependent on another factor as well. This is the nature of the materials used in these walls and the manner in which they are constructed. It has been mentioned in former articles of this series that different substances vary in accordance with the ease with which they transmit heat when they come in contact with hotter or colder bodies. The best illustration of this phenomenon is to touch a piece of wool and an iron bar, both in the same room and hence of the same temperature. The piece of wool feels warm to the touch, while the iron bar is much colder. Hence, if it is desired to retain heat within a substance it is well to surround it with a material like wool, which will conduct the heat slowly, in contradistinction to metals, which all conduct heat rapidly. The construction of the walls and ceilings and floors is also of considerable importance, for they can be made in various ways in order to conserve the heat within the buildings. The number of windows in the building must also be taken into consideration.

Air Required for Ventilation and Heat Requirements

The second factor that influences the amount of heat that must be supplied to a room is the quantity of air that is drawn into that room or building for ventilating purposes. This air may come into the building through infiltration or else it may be purposely introduced into it. This factor must always be taken into consideration in designing an installation for heating a house or room, and it is easy to see that the amount of air that will be required for ventilation will vary greatly in accordance with the use to which the building is put.

Heat Supplied

Against the heat requirements there may be arrayed the heat that is supplied, in addition to the heat that comes from the furnace. This additional heat will come from the persons in the room or buildings, from lights, machinery and motors, etc. This quantity of heat may be deducted from the heat necessary to keep the building or room at the proper temperature.

Fundamental Formula

The fundamental formula which can be used in calculating the requirements which any heating installation must meet can be derived from the principles described above. Thus, if the total heat required is called H, the heat losses by transmission A, the heat loss caused by heating up the air introduced to ventilate the room or building by B, the heat derived from other sources besides the furnace C, the basic formula may be written as follows:

$$H = A + B - C.$$

In this formula the quantities of heat are figured in B. T. U. per hour.

Ventilation

Before proceeding further with the development of this formula and its application, it is necessary to give some attention to the principles of ventilation, for every house heating installation must be considered from the standpoint of ventilation as well as heating. In other words, not only must the air within the house be heated, but also the air that is drawn into the house for ventilating purposes. In an ordinary house this air will come in by infiltration but in large buildings, public halls, theaters, factories, etc., the air must be drawn in and circulated about by mechanical means. The question now arises, what is the proper amount of air that must be brought into the structure for this purpose? It is evident that it must not be too large or else the fuel consumption will be large, and then again it must be sufficient to insure good ventilation.

The purpose of ventilating a room is well understood. It is to remove vitiated air and replace it by fresh air. Natural ventilation will bring this about through the heated air rising in the room and being replaced by colder air drawn in by infiltration. The direction of the wind will have an important bearing on the effect produced by natural ventilation. Mechanical ventilation, on the other hand, is produced by moving the air through the building by means of fans or blowers. There are a number of different systems of mechanical ventilation which possess peculiar advantages and disadvantages of their own.

Necessity of Ventilation and Nature of Vitiated Air

A few words may be said about the necessity of ventilation. In recent years the importance of this subject has become evident and it is safe to say that no large building or hall is designed these days without some consideration being given to the problem of ventilation. Vitiated air, air filled with odors and dust, in which the carbon dioxide content has been increased by the exhalations from the lungs of humans and animals, is now known to be productive of throat and lung troubles, besides being a decided impairment to the efficiency of workers who have to breathe it. The presence of an increased amount of carbon dioxide in the air means a decreased proportion of oxygen, which is the real cause of the dangers of vitiated air. Ventilation is also important from the standpoint of the humidity of the air and its relation to bodily health and comfort. This is a

matter of such importance that we are going to leave a special part of this series for its discussion.

The Amount of Air Required

The important consideration in the discussion of ventilation is the amount of air that is required to produce good ventilation. It will, of course, be dependent on the rapidity with which the air in the room becomes vitiated due to the respiration of its occupants. Ordinary pure air contains 20.26 per cent oxygen, 78.00 per cent nitrogen, 0.04 per cent carbon dioxide and approximately 1.50 per cent moisture. The latter figure is variable. Respired air contains 16.2 per cent of oxygen, 75 per cent of nitrogen, 4.0 per cent carbon dioxide and 5.0 per cent of moisture. In other words, the carbon dioxide content in respired air increases a hundred-fold. If the fact is borne in mind that, when the air in a room contains six to seven parts per 10,000 parts of air, the effects of bad ventilation begin to be felt, and that when the carbon dioxide content of the air increases to ten parts per 10,000, actual discomfort and headache are experienced, it will be understood that the air within a closed room with no or poor ventilation can quickly become unbearable to the occupants of the same.

Air Required in Breathing

Each time that an adult breathes in air, when at rest, 20 cubic inches of air is sucked into the lungs. As the average number of respirations is from 16 to 24 per minute, a total of 320 or 480 cubic inches of air are required per person per minute. This is approximately one-quarter of a cubic foot. Exhaled air contains four hundred parts of carbon dioxide in 10,000 parts of air; hence in an hour's time an adult at rest will exhale 0.6 cubic foot of carbon dioxide gas ($0.25 \times 60 \times 0.04$). If it is assumed that the air within the room must be kept in such a state of ventilation that no more than six parts of carbon dioxide are present in ten thousand parts of air, and that the external air contains four parts of carbon dioxide per ten thousand parts of air, then the gain in carbon dioxide is two parts per ten thousand, which is allowable. This gain comes from the respiration of persons within the room. Hence, if one person produces 0.6 of a cubic foot of carbon dioxide per hour, there will be required three thousand cubic feet of air per hour per person to keep the air in the room in a reasonable state of purity. This figure is found by dividing 0.6 by 0.0002, which is the quantity of carbon dioxide gas mixed with every cubic foot of air entering the room.

Air Required Per Person in Ventilation of Various Classes of Buildings

The air that is required per person on the basis of different proportions of carbon dioxide gas, considered as allowable in the air in the room, is given in the following tabulation, which is taken from the handbook, Mechanical Equipment of Buildings, by Harding and Willard, volume 1, Heating and Ventilation:

The first column of figures represents standard parts of carbon dioxide in 10,000 parts of air. The second and third columns represent the number of cubic feet of air, containing 4 parts of carbon dioxide per 10,000 required per person, on the assumption that 0.6 cubic foot of carbon dioxide is produced per hour.

	Per minute	Per hour
5.0	100.0	6000
5.5	66.6	4000
6.0	50.0	3000
6.5	40.0	2400
7.0	33.3	2000
7.33	30.0	1800
7.5	28.6	1714
8.0	25.0	1500
9.0	20.0	1200
10.0	16.6	1000
15.0	9.1	545
20.0	6.2	375
30.0	3.8	231

It is, of course, understandable that there is another factor which influences the quantity of air that must be introduced into a room to maintain good ventilating conditions therein and that is the size of the room, or better the number of cubic feet of air in the room per individual. It is conceivable that the number of people that are in the room will have a marked effect on the degree of ventilation required. The following tabulation shows the volume of air that must be introduced into a room to maintain a certain standard of purity and the relation between this and the number of cubic feet of space in the room per individual, or, in other words, the number of people in the room.

	Proportion of carbon dioxide in 10,000 parts of air not to be exceeded at the end of an hour						
Cu. ft. of space in room per individual	6	7	8	9	10	15	20
	Cubic feet of air of composition 4 parts of carbon dioxide per 10,000 to be supplied in the first hour						
100	2900	1900	1400	1100	900	445	275
200	2800	1800	1300	1000	800	345	175
300	2700	1700	1200	900	700	245	75
400	2600	1600	1100	800	600	145	none
500	2500	1500	1000	700	500	45	
600	2400	1400	900	600	400	none	
700	2300	1300	800	500	300		
800	2200	1200	700	400	200		
900	2100	1100	600	300	100		
1000	2000	1000	500	200	none		
1500	1500	500	none	none			
2000	1000	none					
2500	500						

This tabulation shows clearly how the amount of ventilation reduces, as the space per person in the room increases or as the number of people in the room decreases.

The amount of ventilation required is also dependent on the character of the building and the purpose for which it is used. The following tabulation shows the quantity of air required per person in different kinds of buildings. It will be understood

that these figures are standard and are based on practical experience with the ventilation of the different classes of buildings described. Here again the figures are given in cubic feet per hour.

Type of building	Cubic feet of air required per hour per person
Hospitals, dependent on the character of the same	2500 to 6000
Schools, theaters, prisons and assembly halls	1800
Factories and shops	2000
Factories, unhealthy trades	3500
Churches	1200

Purpose of Tables

The gas engineer in designing a heating installation or in calculating the number of cubic feet of gas that will be required to keep a certain structure warm must take into consideration the air necessary to procure proper ventilation of the same. The purpose of including these tables in this discussion is to afford him some standard data which can be used in making the calculations involved in determining the size of the heating plant and the amount of fuel required to run it.

Changes of Air in Rooms

It is always best to calculate the amount of air required for ventilation on the number of occupants in the room. Under certain conditions this information is not available and in order still to be able to carry out the calculations in an approximately accurate manner the number of changes of air that have to take place per hour is used in place of the number of cubic feet of air required per person. This factor must also be used in those rooms where the number of occupants is constantly changing. The number of changes per hour will then give the required volume of air. The principal consideration in using this method of determining the air necessary to give good ventilation is the character of the rooms, that is, the use to which it is put. In the case of hospitals, the character of the individuals in the room must also be taken into consideration, as contagious diseased patients must be given more air than others. Standard practice on the number of changes of air in different rooms of a building is given in the following tabulation:

Character and use of room	Changes of air per hour
Private residence—	
Hall	Three
Sitting room, etc.	Two
Sleeping room	One
Offices, public	Four to five
Private	Three to four
Public waiting rooms	Four to five
Public toilets	Five to six
Churches and assembly halls	One to two
Libraries, public	Four to five
Private	Three to four
Public dining rooms	Four to five

Heat Derived from Other Sources Than the Furnace

This digression has served to develop the standard practice in determining the air required for ventilation of a structure or room. After this quantity is known, a calculation may be made to determine the amount of heat that will be consumed in heating this air from the external temperature to the temperature that it is desired to maintain in the room. It must be remembered that even where no special effort is made to see that the room or building receives the required quantity of fresh air per hour, air will infiltrate into rooms through windows, cracks, doors, etc. This matter will receive further discussion later.

Thus the factor B in the equation:

$$H = A + B - C$$

is determined. The next step is to determine the factor C, which is the amount of heat that is supplied to the room besides that which actually comes from the heating furnace. While this quantity cannot be very great, nevertheless under certain conditions it may be desirable to take the matter into consideration.

Heat from Other Sources

Here again use is made of standard tables. The first question is, how much heat is given up by people. This will depend whether they are at rest or working, as well as on the ages of the same. The following tabulation shows clearly the factors that must be used in taking into consideration this source of heat supply:

Occupant of room	B. T. U. per hour
Man at work	794
Man at rest	397
Youth	357
Infant	103

Another source of heat is the light that is used in illuminating the room. The amount of heat developed by different kinds of lights is given in the following tabulation, both in B. T. U. per hour per candle power and in B. T. U. per hour for the type of light of standard candle power:

Illuminant	B. T. U. per hour per candle power
Gas, ordinary split burner	300
Gas, Argand	200
Gas, Welsbach	31
Petroleum	100
Electric, incandescent	14
Electric, arc	4.3

	B. T. U. per hour
One gas jet 16 candle power	3000
One Welsbach light	640
One arc light, 1200 candle power	3600
One incandescent light 16 can. power	160

Heat may also be developed by machinery, motors, etc. It is generally estimated that the heat equivalent of the work done and set free is 2,545 B. T. U. per horsepower hour or 3,415 B. T. U. per kilowatt hour. The necessity of taking into account this heat as well as the heat developed by occupants and by the lights used is evident, inasmuch as the air of

the room or building will be overheated if sufficient ventilation is not provided to introduce fresh air and thus keep the temperature of the room down to where it belongs. Then this will be further reflected in the amount of fuel burned in the heating furnace.

Loss of Heat Due to Transmission Through Walls

The last factor in the aforementioned general equation, designated by the symbol A, is the loss of heat that is incurred due to the transmission of heat through the walls, ceilings, roof, floors, etc., of rooms and buildings. The principal factor that controls this heat is the manner in which the construction of the building is carried out. The temperature of the external air and of the air within the room, or rather the temperature differential, is also of importance.

Conduction, Convection and Radiation

In considering this problem of the amount of heat required to keep a room or building warm it is necessary to study the ways in which heat can be transmitted from a warm to a cold body. There are three such ways, radiation, convection and conduction. They are all of prime importance in house heating.

In the first place, it is evident to all that heat travels. The truth of this statement is easily demonstrated by standing in front of an open fire. The transmission of heat by convection and conduction is fairly easy to understand. When the end of an iron rod is heated, the other end held in the hand will gradually get warm until it can no longer be touched. This is called conduction of heat, the heat from one particle of the iron being transmitted to the next one in direct contact with it. The particles of matter remain stationary; they do not move. Both liquids and solids will conduct heat.

On the other hand, when air or other gas is heated, it expands and a change in its density takes place, with the result that air currents are produced and the heat is carried from the hotter to the colder parts of the room, which may be heated by a radiator. This is known as convection of heat and implies that the heated substance circulates and carries its heat with it to colder parts. Thus we heat a body of water from the bottom. As the layer of water becomes heated and hence lighter in weight than the layers of water above, it rises to the surface, convection takes place and the mass of water is quickly heated to the desired temperature. But this takes place only when the water is heated from the bottom, not from the top.

The third method of transmitting heat is by radiation. Radiant heat passes directly through the air from the heated body without appreciably heating the air itself. The best example of the radiation of heat is the transmission of the heat of the sun through millions of miles to the earth. The intervening medium has no effect on the radiation of heat. A good illustration indicating the effect of radiant heat is to stand before a bonfire on a cold day. The air touching the face is almost cold, but the heat radiated by the fire will blister the face. In this case the heat is not transmitted by the movement of current of air but by radiation.

These Factors and Their Relation to House Heating

In house heating all three processes take place. In the first place the heat from the radiator is transmitted both by radiation and convection. The heat radiates from the radiator as it would from a fire. Then the layers of air which come in contact with the warm surface of the radiator become heated and lighter in weight and the warm air rises to the ceiling of the room. Convection currents are thereby set up and heat is continually transmitted away from the hot body by the movement of the air. The hot air in coming in contact with the walls of the building or room heat them and the material of which these walls are made conduct the heat from the inside to the outside of the structure. Thus heat is transmitted by conduction.

Before proceeding further with the calculations on this subject, attention must be called to the fact that the various materials used in the construction of the walls possess different rates of both conduction and radiation of heat. These factors must be taken into consideration in the formulae that are used in making these calculations. The detailed calculations involved in this matter are too complex for consideration here and in place of going through these calculations, factors for heat losses through walls of different construction and different thickness will be used in place. The calculations are considerably simplified by the use of these factors.

We reserve the next article for a discussion of these calculations.

INSULATE COBWEB WIRES BY GAS HEAT

Copper wire so fine that one pound of it measures more than six miles, is now being coated with an insulation of flexible enamel and baked in gas-fired ovens, the temperature of which is automatically controlled within the exacting limits required for this delicate work.

Enamelled wire for electro-magnet windings is used because enamel adds less to the diameter of the wire than the ordinary silk or cotton insulation and is materially lighter in weight.

Baking enamel on wire only three one-thousandths of an inch in diameter demands an evenness of heat obtainable only in a thermostatically controlled oven, for the enamel must be finished to withstand the twisting and pulling incident to winding the magnet. If it is brittle, it breaks off, and if it is too soft it wears off, in either case producing a worthless magnet.

The slender copper wire must pass through the oven four times to receive the four coats of enamel that complete it. Any surge of heat in the oven would break the wire, and a fall in temperature would ruin the insulation. The gas ovens developed for this work have proved so successful that already more than 80 per cent of all the enamelled wire used in the country is made by their use.

Operating Experiences and Results Obtained with Use of Bituminous Coal As Generator Fuel in Eleven Foot Sets*

By W. J. Murdock

Superintendent Coal Products Manufacturing Company, Joliet, Illinois

UNTIL January 1, 1921, the Coal Products Manufacturing Company was primarily a by-products coke oven plant, equipped with three eleven-foot U. G. I. water gas sets as auxiliary equipment. These water gas machines were equipped and checkered for coke operation. During the year 1920, due to various causes, we were unable to get sufficient coking coal to operate our ovens at capacity enough to supply our gas demand. Due to this fact, we made blue gas on our water gas machines, using mostly pea coke as generator fuel. This blue gas was mixed with some lean gas from the ovens and used to reheat the ovens, thus enabling us to get a larger surplus of gas per ton of coal for distribution. On January 1, 1921, the management of our company decided that we would experiment with the use of bituminous coal as generator fuel, and accordingly during the month of January we made blue gas with bituminous coal as generator fuel. By February 1, 1921, due to the fact that coke had become a drug on the market, our coke oven plant was shut down and we went to the manufacture of carburetted water gas with bituminous coal as generator fuel.

At this time our installation consisted of three eleven-foot U. G. I. sets, which were hydraulicly operated. The present installation consists of five eleven-foot external diameter U. G. I. water gas sets, with the high capacity rating of 3,500,000 cubic feet of gas each per day, using good coke and 42-inch blast pressure. Each of these sets is operated in conjunction with a U. G. I. vertical waste heat boiler, which is arranged to handle both the make gas and the blast gas from the sets.

The boilers deliver their steam at a pressure of about 125 pounds per square inch to a high pressure header. This header supplies the turbine driven blowers and pumps with steam. Any excess steam goes to the boiler house to supplement that generated by the coal fired boilers located there. The turbines and pumps exhaust into a low pressure header, where a pressure of about five to six pounds per square inch average is maintained. This low pressure header supplies steam to sets during the steam run and helps to heat the feed water for the waste heat boilers. One turbine blower is used to operate two or three sets, since it supplies sufficient air for operation with coal under prevailing conditions. Any deficiency of steam in the low pressure header is made up by steam from the high pressure header through reducing valves. It is interesting to note that, due to the wire drawing effect through the reducing valves, the low pressure steam is superheated from 25 deg. to 35 deg. F.

The sets are all equipped hydraulicly and are operated by Model "A" U. G. I. automatic controls, which system does much to eliminate the human element, enables us to run a short cycle, and keeps the operation uniform. Each of the sets is equipped with pyrometers, three being of the indicating type and two of the recording type. For regulation of operation we have the machines equipped with U. G. I. air meters and the steam is measured by Republic flow meters. Within the last eight months the checkerbrick have been removed from the carburetors and we are now using U. G. I. high pressure oil neubulizing system on all the machines.

Fuel for the sets is elevated by a belt conveyor from a track hopper to an overhead one hundred thirty-five (135) ton bunker which has been divided into two compartments, one being half as large as the other. Last fall we installed a "Hummer" electric screen, made by the W. S. Tyler Company, at the head end of our conveyor just before the coal drops to the bunker. By an arrangement of chutes the lump coal goes over the screen into the larger compartment and the screenings drop through into the smaller compartment. In order to prevent breakage of the lump coal, the larger compartment is kept well filled at all times, as Illinois and Indiana coals break up very easily on being dropped any great distance. The lump coal is drawn off into larry cars running on an industrial track parallel to a line through the coal holes of the five sets. Each larry car has a side spout and coal valve and an auxiliary door in the side of the larry car which on raising increases the size of the opening from the car to the

*Delivered at the annual meeting of the Eastern States Gas Conference in Philadelphia, Pa., April 10, 1924.

spout, better enabling us to handle large lumps. From this car the fuel is charged into the generator and is evenly distributed over the surface of the fire by means of a specially designed scoop which is handled by the gas maker.

The fine coal is drawn off into one of the larry cars and by means of a chute is dumped into a coal car which is spotted on the railroad track below the operating floor. This coal is used in the boiler house.

Each set is equipped with a blow run cylinder which enables us to keep air under the generator with the steam off and stack lid down. Each of our blowers is equipped with a Tagliabue regulator, which enables us to maintain our blower pressure at a set amount.

As stated in the first part of this paper, we started soft coal operation with three U. G. I. sets, checkered for coke operation, and not equipped with waste heat boilers. The first serious difficulty we encountered was, of course, a low make per set. Each set giving us approximately 1,500 M. per 24-hour day, and this having to be accomplished at times by use of some coke. Inasmuch as we had to keep up our gas supply, having 64 towns depending on us for gas, it became necessary to run our auxiliary plant at Aurora, which consists of two 8 ft. 6 in. U. G. I. water gas sets.

In order to maintain capacity we attempted to operate with high blast pressure, and to simulate conditions with coke operation. After about ten days to two weeks operation with soft coal, the back pressure in sets proper became so excessive that it was almost impossible to charge the generators, due to excessive flames thrown out of the generator hole when fresh coal was charged to generator.

By taking pressures throughout the set during the blow, we determined that both carburetor and superheater were badly plugged. This necessitated going back to coke operation long enough to shut down one machine at a time to rechecker. At rechecking we found both carburetor and superheater plugged about 75 per cent with a fine coke which we now call blown over fuel. Not having heard of anyone experimenting this trouble on small sets with soft coal as generator fuel, and from all previous data which we had, we thought that it was absolutely necessary to get as much brick area as possible for efficient cracking and fixing of the oil. So we accordingly again rechecked as we would for coke operation.

Immediately after the machines were rechecked we went back to 100 per cent bituminous coal as a generator fuel. With the idea of reducing the amount of fuel blown over to the checker chambers we emptied the dust collector every two or three hours.

We opened up the bottom of the carburetor and superheater every two to three days to remove the accumulation of fuel on the bottoms. This accumulation and removal from the dust collector at times amounted to as much as eight or ten pounds per M. cubic feet. This operation lasted about three weeks, when we began to notice from pressures we were taking daily throughout the setting, and from the pressure at generator lids on charging, that the sets were becoming plugged up. At the end of four weeks it again became necessary to rechecker the machines, and we were forced to use coke as generator fuel, taking down one machine at a time for rechecking.

At this time it was decided that something must be done to let this blown over fuel drop through the checkering to the bottom in order that the same might be readily removed. We decided to go to a 3-inch straight flue or chimney effect checkering, which we placed in the first set we rechecked. We also figured that if by some method we might increase the velocity of the gases through the off-take from the generator that the blown over fuel carried with them would drop out in the dust collector, rather than being carried into the checker chambers. We accordingly drew in the lining on the off-take from 36 to 20 inches diameter. This drawing in did us no apparent good. After considerable figuring and taking into consideration the reduced make per set day, we decided to rechecker the next two machines with 6-inch straight flue in the carburetor and superheater. After all the machines had been rechecked in this fashion, we again went back to 100 per cent soft coal. This method of checkering apparently did not injure our oil results, and due to increased demands in send-out the machines were kept in service for about seven months before rechecking.

We had not operated on soft coal very long when it became apparent to us that soft coal fires would not stand the high rate of blasting. From what little we could see of the fires we knew that some had considerable blow holes and the activity was around the outer periphery of the shell and considerable of the center was seemingly inactive. Up to this time we had been running our No. 9 blowers, which are designed to give 21,000 cu. ft. air per minute against 42-inch pressure. We did not have any hand controlled butterfly in our blast main, and the only way of reducing the amount of air was by either slowing down the blower or partially closing the generator blast valve. After various experiments we decided to install a Tagliabue pressure control valve ahead of the throttle valve on our blower. The control line of this regulator was hooked up to the blast main proper. The regulator can be set for any given pressure and the speed of the blower is controlled accordingly. This system did a great deal to relieve us of excessive blast pressure, which at times previously would build up to the full capacity of blower, namely 42 inches.

After having installed these regulators, we ran a series of tests cutting our air per M. down as low as 4,000 cubic feet, but we were unable to continue with this, due to the fact that we jeopardized our make seriously. We, however, did determine that 7,000 cubic feet of air per minute in the generator was about the limit we could use and maintain any kind of efficiencies and make. Most of our operation since has been on the basis of 7,000 cubic feet of air per minute. We, however, are, at the present time,

doing other experimental work along these lines, and some of this work will be noted later in this paper.

In our early operation we were unable at any time to get a good look at the generator fire upon coaling. The heights and distribution of our fuel was determined by feeling in the dark, as it were, with a bar. We tried reversing the hot valve, thinking that the gas would be pulled off through the ash pit, thus enabling us to see top of the fire. This was done without success. We had also tried previously to draw the gases away at coaling, by throwing a steam jet into the top of superheater stack, but this also availed us nothing.

About this time the contract was let for another new set, three waste heat boilers, and automatic controls and exhaust steam connections to the sets. We also arranged that each of the old sets, as well as the new one, would be equipped with a quick opening door in the back of the superheater, to better enable us to remove the blown over fuel from the bottom.

The waste heat boiler installation proved a very good means of drawing the gases off the top of fire during coaling. This was accomplished by reversing hot valves and due to the great height of the waste heat boiler stack, the gases were drawn down through the fires, giving us a clear view of them as they actually were.

The first fire seen by the use of this method brought us to the realization that our fire conditions were anything but what they ought to be. Our cycle of operation is as follows: All split runs, 50 per cent down steam, 2 minute blow, 2¾ minute steam run, ¼ minute purge. The coal is charged about every eight runs and we put in on an average 2,200 pounds per charge. The first blow after coaling is of one minute duration and then blow run into the holder for from one to two minutes, depending upon fire conditions. This is followed by a steam run and then the balance of the cycles are as stated in the first part of this paragraph. The only blow run we use is the first cycle after coaling.

With this operation we find on opening the generator for coaling that upon looking down into the fire, through the coaling hole, one will note certain bright spots, generally not far from the periphery. Upon poking down through these spots with a light bar, we find that the coal has disappeared from underneath and there will be a settlement of as much as two feet or more under this bright spot. We will also note that at times there are holes as much as two to three feet in diameter running from the top of the fire very nearly to the grates. These holes and bright spots do not occur consistently in any one place, but vary all around the generator. The fires in the majority of cases being low on one side and high on the other. This condition arises after the fire has been well leveled off after clinkering, and on each successive coaling.

In order to remedy the above condition we had a light paddle bar made, and each time the generator was opened for coaling and before the coal was admitted, the gas maker pokes these weak spots with the use of the light bar and settles his fire wherever it needs it.

By the use of a specially designed scoop (sketch of which is given) the coal going to the generator is evenly distributed, extreme care is exercised to see that the fire after coaling is dish shape, that is, high around edges and lower in the center. The best conditions of fire levels we have found with our particular type of installation, and from many and varied experiments has been to have the fire level about 1½ feet below the bottom of the off take after coaling. In table No. 1, attached herewith, you will note that with the lower fire level the gross fuel per M. is from 2 to 3 pounds less, the blown over fuel is from 1 to 2 pounds less per M., and the oil per M. is from four-tenths to five-tenths of a gallon less. This table we believe brings out the point that, especially with large sets, we do not want high fires or high rate of blast.

Realizing the condition of channeling in our fires, and the very inactive center, we set out to find some means of overcoming these conditions. Some of which we shall briefly enumerate.

First: Knowing that we had to drive air and steam to center of fire, we decided to leave a side wall clinker about two feet in width on generators. This clinker was formed, of course, just above the door arches. We did not allow this clinker to get any larger, and at cleans we cut off enough to keep it at the aforementioned width. This availed us nothing.

Second: We placed an annular ring about one foot wide on top of the grate, and just small enough in circumference to go inside the shell lining. This with the thought that the steam and air would be directed more through the center of the fire than previously. This idea was carried as far as to make the ring into a plate which covered the entire grate, save for a 20-inch hole in the center. From all data we gathered we could not see that this helped in any way.

Third: We built a fire brick pier or cylinder in one generator about two feet in diameter and to a height about level with the off-take. About 1½ feet above grates on this cylinder we made a solid tile baffle, and below this baffle were ports for air and steam to come through. The rest above this tile was a hollow cylinder closed at the top. The idea of this cylinder was to give the air and steam more periphery about which to work. The installation of this cylinder gave promise of some very encouraging results, inasmuch as the fire in this generator seemed more active than the other fires, and the blown over fuel in this set was reduced about 50 per cent. The brickwork, however, did not withstand heat conditions in the generator and the cylinder did not last over ten days. Other experiments coming along at this time took precedence and we have never gotten back to work along this theory. We, however, have this in mind, and hope to work at it in the near future.

It might be well for us at this point to explain our theory of why it is easier to get nearer the same capacity with soft coal operation, as obtained with coke operation in smaller sets, as against that obtained in a larger set. To make this point clear we will assume two U. G. I. sets:

(Continued on page 351)

GAS MERCHANDISING

Domestic – Industrial

Easter Gift Displays of Gas Appliances

A few suggestions on window displays

Ernest A. Dench

There is a lot of stray gift money floating around at Eastertide. The combined advertising and display efforts of public service companies and retail establishments have done much to popularize the giving of Easter gifts. The gift periods used to be confined to Christmas, birthdays, weddings and graduations, but now, slowly, but surely, Easter is being brought into the net.

Easter used to mean an exchange of greeting cards and candy eggs and toys for the kiddies, with perhaps a potted lily for home adornment.

The Easter gift problem narrows down to this: To make money, you must spend money. People begin to realize that spring is here, so they want to brighten up their homes, wear new clothes and have a change of diet after a long spell of winter. These tendencies, particularly the home ones, are reflected in the gas company's receipts for April.

But—and a very LARGE BUT—folks are not going to get in the gas appliance purchasing mood unless you present seasonable display appeals and indulge in timely newspaper advertisements. If, for example, you spend twenty-five dollars on a special Easter window display, and it produces three hundred dollars worth of business, the expense will have been amply justified.

Since you prefer facts rather than theories, we are giving some examples of striking displays that were arranged last Easter.

Easter Drive-on Portable Gas Lamps

We rather admired the Easter "atmosphere" in the portable incandescent gas lamp display by Lawrence C. Heiss, display manager, United Gas Improvement Company, Philadelphia, Pa. Mr. Heiss got this "atmosphere" across in several pleasing ways. The low panelled background was draped with pale yellow taffeta, each panel being divided by a narrow drape of purple velvet. A purple velvet valance across the top, rear and sides was fringed with gold. The floor space was rippled with a brocaded silk in a rich purple pattern. Near the rear center, set on a pedestal, was a bronze statuette of a child to represent the Spirit of Springtime. A drape of the purple brocade was coiled around the raised arm of the child, the ends of the drape concealing the pedestal and trailing to the floor. Flanking this, on either side, was a little palm nookery, produced by placing several large pots of artificial palms close together. The red earthenware pots were placed inside large wicker containers.

Across the front of the trim at equal distances apart were four small stands, on each of which one of the table gas lamps was exhibited. The top surface of each stand was buried under a layer of purple wax paper shavings. The lamp was set in the middle of these, surrounded by several stuffed baby rabbits and chicks. The effect obtained was that of several nests, each protected from the weather by a gay looking parasol (the decorated shade of each lamp suggesting the latter). In life-like attitude about the floor were a number of toy rabbits and chicks. A framed card at the front center conveyed the fact that—

"The Light from a Portable Incandescent Gas Lamp is as cheerful as a sunbeam."

At night the window proved the truthfulness of the sign.

Easter Display as Good Will Builder

The People's Gas Company, Chicago, Ill., employed one of their displays at Easter to build up good will more than anything else. It served to prove that a public service company can be human and is not a cold-blooded money-making machine, as it is often erroneously depicted.

Their display, captioned as "An Easter Intrusion," contained a strong human interest appeal, for one and all, young and old, are interested in rural scenes. In the background extending straight across and then turning obliquely frontwards at both right and left, thus forming an inclosure, was an ancient home-made, weathered picket fence, against which gaily colored artificial hollyhocks were blooming. Toward the middle, on a dilapidated chair, whose back was almost broken off, was a medium-sized soap box filled with straw. The chair was close to the fence, while over the box, and extending from the fence, was an improvised tin roof. On the straw a ruffled red hen had spread herself to the utmost in the vain effort to conceal the fluffy yellow chicks that had just emerged from the shells. The hen and chicks were all stuffed specimens. Through a hole in the fence at the right two huge white stuffed rabbits had intruded on the hen's preserves. One rabbit stood on his hind feet, with his two front paws on the hen's chair. The other rabbit crouched on the grass, with which the floor was covered, ready to assist his partner if necessary.

Getting Pointers from Other Trades

This ends our selection of strictly gas company display ideas for Easter. It is always helpful to obtain display pointers from other businesses, especially when these can be adapted to gas appliances, as in the following examples:

The whole story of Easter, as relating to new life, the resurrection and springtime, was ably portrayed in a single display by the H. & S. Pogue Company, Cincinnati, Ohio. This, too, would make an excellent good will type of trim for Easter, since it did not offer anything for sale. Both the background and floor space were gracefully draped with rich black velvet. To the left was a life-like lion (the March Lion), while near this was a lamb (the Spring Lamb or the Lamb of God). In between these was the figure of a child dressed in pure white. The two animals were stuffed toy specimens, while the child was a wax figure. The extreme right rear corner was occupied by gilt organ pipes (decorated board cut-outs), which contrasted well with the rich velvet background. Underneath the organ pipes was a pulpit, draped with black velvet, while on the improvised reading desk rested a Bible. A large vase of Easter lilies reposed near the central part of the background.

Toast for the Easter Breakfast

An Easter window we noticed out in Indianapolis would afford a good tie-up for selling gas toasters in conjunction with the "Eat More Wheat" campaign. The background consisted of a large pasteboard circle, light green in tone. Placed against the circle was a small, light yellow picket fence, equipped with an open gate. This was also of pasteboard. Gas toasters could be fastened to the tiny yellow and green pasteboard disks that surrounded the circle, backed up by a card worded somewhat as follows:

"Served the Easter Breakfast Eggs with Deliciously Browned Toast, such as may be obtained with a Gas Toaster."

Novel Easter Background Effects

If you are seeking novel background effects to introduce in your Easter Gas appliance displays, an excellent idea was worked out last year by Silverwood's, Los Angeles, Cal. Screens about four feet wide by three feet high were placed at regular distances apart along the background and sides. These screens were of gilded board, with a large oval portion cut away from near the top of each screen. Through this opening was placed a real Easter lily. This was placed in a pot at the back of the screen and helped to produce the illusion of being painted on the screen itself.

Rabbit Window Cards

Strong in selling value was the unique form of window card publicity employed last Easter by Wright & Downings, Marceline, Mo. A number of colored cardboard rabbits were placed beside the articles on display. Each rabbit bore in his paws a little card telling about the merchandise he presided over. The same idea could be also carried out with some stuffed toy rabbits.

Easter Service Appeal

If you are interested in presenting gas company service with an Easter appeal, the card employed by John A. Schwarz, Inc., Brooklyn, N. Y., may appeal to you. This was worded in the following vein:

"Our Easter faith is that service will pay."

The card was bordered with yellow, topped with a clump of Easter lilies, with the central part of the card in purple. The script was in white.

TWENTY BILLION CUBIC FEET INCREASE NOTED IN USE OF MANUFACTURED GAS

Consumption of manufactured gas in the United States has increased by twenty billion cubic feet in a year, according to the Pennsylvania Public Service Information Committee. Estimates show that the sales last year were approximately 370 billion cubic feet.

New customers are being added to service mains at a rate in excess of 400,000 a year, with annual sales of appliances aggregating 750,000 ranges, 425,000 water heaters and 400,000 space heaters. Sales of merchandise by gas companies are also continuing at a high rate, the estimate for last year being in the neighborhood of $45,000,000, or approximately $5 a meter.

INDUSTRIAL GAS LESSONS

IF IT'S DONE WITH HEAT — YOU CAN DO IT BETTER WITH GAS

Lesson No. 15

The transmission of heat (continued)

Thermal Conductivity

Substance	B. T. U. conducted per hour per square foot section per degree F. per inch thickness.
Metals—	
Aluminum	966 to 1000
Copper	2060 to 3250
Iron, cast	440 to 1000
Iron, wrought	350 to 1200
Brass, yellow	592
Brass, red	713
Lead	242 to 250
Silver, highest of all	3180 to 3900
Steel, hard	180
Steel, soft	322
Steel, Bessemer	279.5
Tin	443
Zinc	443 to 770
Other Materials—	
Slate	9.58
Granite and sandstone	15.65
Asbestos	0.65 to 1.96
Asbestos paper	1.245
Boiler scale	16
Carbon electrode	260
Marble, limestone, etc.	13.6 to 16.2
Portland cement	2.06
Plaster of paris	2.03
Brick	4.4 to 13
Charcoal	0.45
Glass	3.19 to 6.88
Ice	17.0
Magnesia	0.49
Rubber, hard	0.25
Soil	0.958 dry and 4.64 wet
Sand, white dry	2.7
Sawdust	0.44
Water	9
Wood	0.25 to 1.38
Wool, cotton	0.10 to 0.48
Wool, mineral	0.26
Wool, sheep	0.33 to 0.44
Chalk	0.58
Firebrick	0.812
Carbon	1.32
Diatomic earth	0.377
Paraffine	0.667 at zero deg. C. and 4.88 at 100 deg. C.
Strawboard	0.871
Pasteboard	1.305
Blotting paper	0.435
Felt	0.252
Cotton wool	0.125
Cotton wool, compressed	0.0957
Flannel	0.348
Haircloth	0.122
Cork	2.08
Leather, cowhide	1.22
Liquids—	
Water—At 0 degrees C	3.48
From 9 degrees C. to 15 degrees C.	3.94
At 4 degrees C.	3.74
At 18 degrees C.	3.6
At 30 degrees C.	4.56
At 108 degrees C.	6.45
Methyl alcohol, from 9 deg. C. to 15 deg C.	1.435
Ethyl alcohol, from 9 deg. C. to 15 deg. C.	1.22
Benzol, from 0 deg. C. to 15 deg. C.	0.972
Petroleum, at 13 degrees C.	1.03
Gases—	
Air	0.1404 to 0.35
Ammonia	0.113
Ethylene	0.1145
Hydrogen	0.95
Nitrogen	0.152
Oxygen	0.163
Methane	0.188
Carbon monoxide	0.145
Carbon dioxide	0.0891

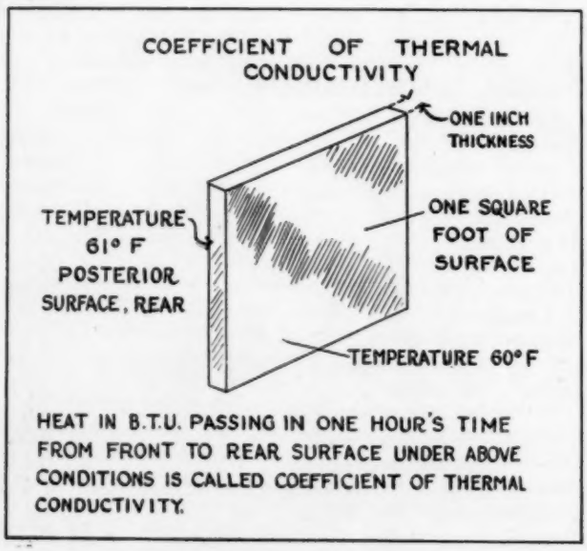
Definition of Coefficient of Thermal Conductivity

The table given above contains a number of constants which are used in heat calculations, involving the rate of conduction of heat by solids, liquids and gases. The fundamental constant, which is termed the thermal conductivity of a substance, is defined to be the number of heat units—B. T. U.—conducted in an hour's time per degree difference in temperature through a slab of the substance which is one square foot in area and one inch in thickness. In other words, it is quantity of heat that will pass through this section of the substance when the temperature difference between the hot and cold side of the same is one degree Fahrenheit. This factor is usually denoted by the symbol K.

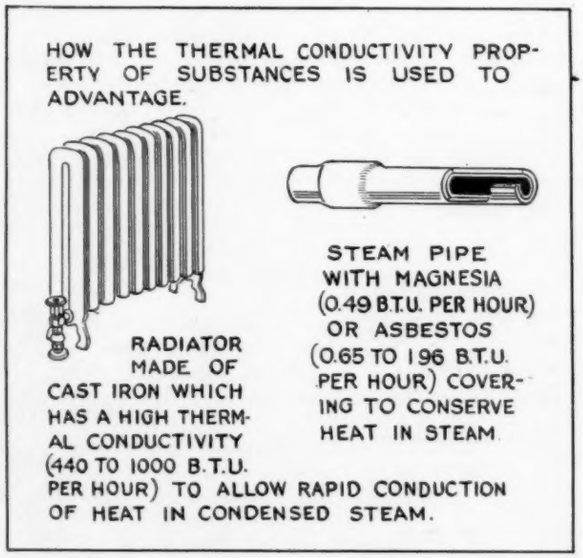
Use of the Figures

Taking an example from the figures, it will be seen that in the case of the metal, tin, 443 B. T. U. of heat will pass from one surface of a slab of the metal, one square foot in cross-sectional area, to the

other surface one inch away, when the difference in temperature between the two is one degree Fahrenheit, while if the slab was made of marble in exactly the same dimensions, approximately only 15 B. T. U. per hour per square foot of cross-section area per inch thickness would be conducted when the temperature difference was similarly one degree Fahrenheit.


COEFFICIENT OF THERMAL CONDUCTIVITY
ONE INCH THICKNESS
TEMPERATURE 61° F POSTERIOR SURFACE, REAR
ONE SQUARE FOOT OF SURFACE
TEMPERATURE 60° F
HEAT IN B.T.U. PASSING IN ONE HOUR'S TIME FROM FRONT TO REAR SURFACE UNDER ABOVE CONDITIONS IS CALLED COEFFICIENT OF THERMAL CONDUCTIVITY.

The importance of the heat conductivity of substances is clearly demonstrated when constructing apparatus in which heat is generated or used and also in arrangements employed to convey heat from place to place. The steam radiator, which has for its primary purpose the discharge of the heat in steam into the atmosphere, must necessarily be constructed of such material that will aid in getting this heat out of the radiator and into the air. Metals are known to have greater heat conductivity coefficients than all other materials, and hence the radiator is made of iron, which has a fairly high rate of conductivity. Then, again, when the boiler is built in which the steam is generated, it is lined with magnesia cement or asbestos or other similar material which is a heat insulator, that is such a poor conductor of heat that it tends to keep the heat within the boiler rather than allowing it to pass through. The reason for using asbestos or magnesia is clearly evident from the aforementioned tabulation, which gives the rate of conductivity for magnesia as 0.49 and for asbestos as 0.65 to 1.96.


HOW THE THERMAL CONDUCTIVITY PROPERTY OF SUBSTANCES IS USED TO ADVANTAGE.
RADIATOR MADE OF CAST IRON WHICH HAS A HIGH THERMAL CONDUCTIVITY (440 TO 1000 B.T.U. PER HOUR) TO ALLOW RAPID CONDUCTION OF HEAT IN CONDENSED STEAM.
STEAM PIPE WITH MAGNESIA (0.49 B.T.U. PER HOUR) OR ASBESTOS (0.65 TO 1.96 B.T.U. PER HOUR) COVERING TO CONSERVE HEAT IN STEAM.

A New Idea In Advertising

Harold F. Podhaski

A full-page advertisement published recently in a Jacksonville, Fla., newspaper, embraces an advertising idea of a co-operative nature that is worth telling about.

A group of twenty Jacksonville merchants took part in the plan, their advertisements appearing on the page. Prizes of a total of $50 were offered for the best short stories, one of the rules of the contest being that each story had to mention some way or another the name of each of the advertisers on the page.

For instance, let us presume that the story concerned a young man and a young lady about to be married. The story would go on and tell from which advertiser they purchased a lot on which to build a home; then it would go on and tell about the equipment of the home, mentioning their purchase of furniture from such and such a firm, their purchase of a gas stove or other equipment of this nature from the local gas company, and so on. In this manner the whole story would continue until the name of each advertiser had been mentioned.

The first prize was $30 for the winning story, the second prize $15 and there were five other prizes of $1 each. The seven winning stories are to be published later in the same paper.

As The Journal Views It

EDUCATING THE GAS EMPLOYEE

Ever since gas first came to be considered as a possible fuel for industrial purposes, the gas companies and gas executives in general became cognizant of the fact that they did not possess the kind of men who would best fill the position of industrial gas salesmen. It was brought home to them that the kind of men that they wanted for their industrial department were not to be had forthwith, as those gas men who could sell gas appliances and gas itself were not engineers and did not understand the principles on which the application of gas as an industrial fuel are based. Then, again, the gas men who were engineers were generally unfamiliar with the art of salesmanship.

Inevitably gas men began then, and are still continuing, to draw comparisons between the conditions in the electrical industry and those that exist in the gas industry, for there is no gainsaying the fact that electricity and gas are competitors, whether rightly or not, in the industrial field. Each time an electrical man put over an industrial electrical heating proposition, in spite of the fact that the price of his fuel, or rather energy, was much greater than anything else that could be used for the purpose, the question must have arisen in the minds of many gas men—how did they do it? It must have made them feel there was no reason why gas could not supplant electricity, because of the simple fact that it was so much cheaper than the electric current.

When the conditions in the electrical industry were examined it was found that for a long time past the industry had been training its men to go after and get all business in sight and had been spending great sums of money in research and had really been pushing electricity into the various fields by sheer force of high grade service and first rate industrial salesmanship. The cadet engineers' training system, which is found in the electrical industry, is noted throughout the entire country for the thoroughness with which it trains men for important positions in the various branches of the electrical organization.

The gas industry within recent years has made great progress in training gas men in the fundamentals underlying the application of the fuel, gas. Courses are given now in many universities and colleges relating to gas, its uses for different purposes, particularly of an industrial character, etc. Some gas companies are also conducting educational courses of their own in which men are given an opportunity to acquire a knowledge of the fundamentals of gas.

A paper was recently read at a Western gas association meeting in which it was told that one of the largest gas companies in the West has inaugurated a cadet engineering course for men who entered the gas industry and wanted to be trained for positions of importance and responsibility in the organization. That this is a real step forward, a step in the right direction, no one will gainsay. It follows in the footsteps of the electrical industry, and in this respect the gas industry can do no better than to take the electrical industry for a model. The men are to be trained in fundamentals and given practical work as well. That valuable gas men, gas engineers and salesmen will be produced by this method is hardly to be doubted. It is the one and only way by which the gas company can develop the right kind of men for the positions that must be filled in their organizations. It gives a man an opportunity to learn while he is working and earning a living.

Educational work of this nature amongst the employees of gas companies is a mighty important feature of the gas business. Any gas company that undertakes such educational work has before it as great examples the success that has been attained by other industries along similar lines. The results have always been gratifying, have always been worth while.

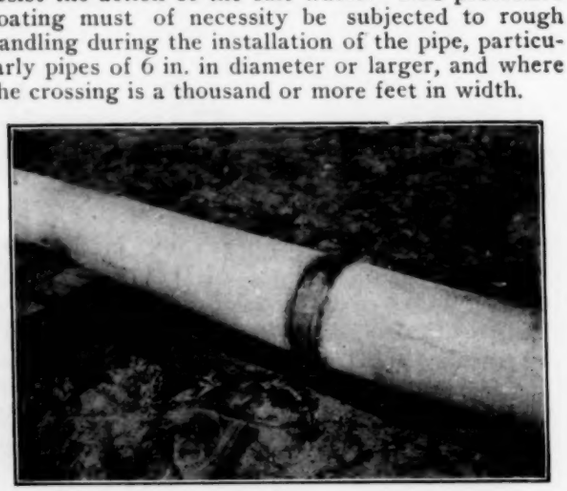
GAS WRINKLES

Galvanized Welded Joints in Pipe Lines

W. H. Rogers

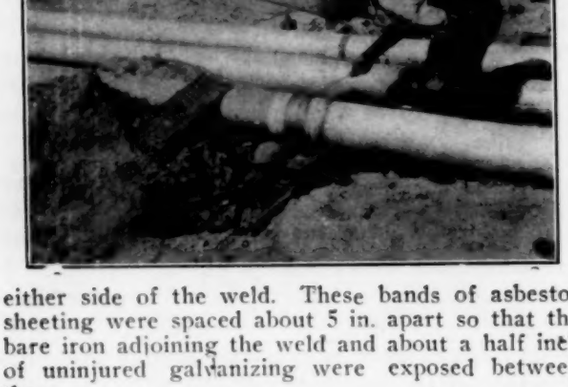
Long Beach, California

Installations of subaqueous gas pipes across channels and harbors present problems not met with elsewhere. One of the most important of these, in the case of steel pipe, is a protective coating that will resist the action of the salt water. This protective coating must of necessity be subjected to rough handling during the installation of the pipe, particularly pipes of 6 in. in diameter or larger, and where the crossing is a thousand or more feet in width.



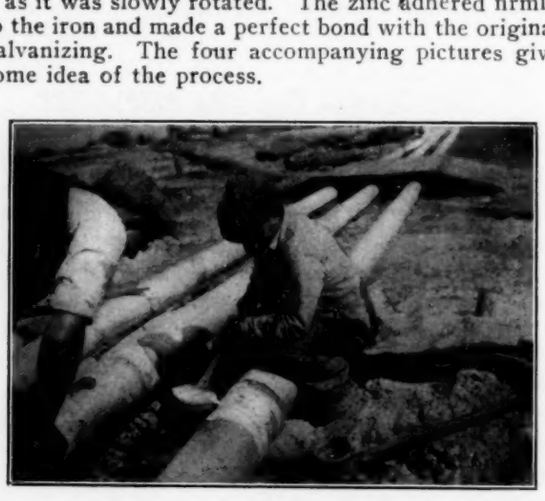
On an 8 in. galvanized wrought iron gas pipe, laid in Los Angeles harbor, the lengths of pipe were fastened together by means of oxygen-acetylene welds and in the process the galvanizing was burned off for a distance of about 2 in. from the weld. To protect these bare places galvanizing in the field was resorted to.

The pipe was first thoroughly cleaned (the sand blast proving the most satisfactory method of accomplishing this); two pieces of asbestos sheeting were wrapped around the pipe and wired, one on



either side of the weld. These bands of asbestos sheeting were spaced about 5 in. apart so that the bare iron adjoining the weld and about a half inch of uninjured galvanizing were exposed between them.

The zinc was melted in an especially constructed gas fired furnace, which could be placed directly under the pipe where the galvanizing was to be done, and after the iron had been given the usual treatment with hydrochloric acid, molten zinc was poured over it as it was slowly rotated. The zinc adhered firmly to the iron and made a perfect bond with the original galvanizing. The four accompanying pictures give some idea of the process.

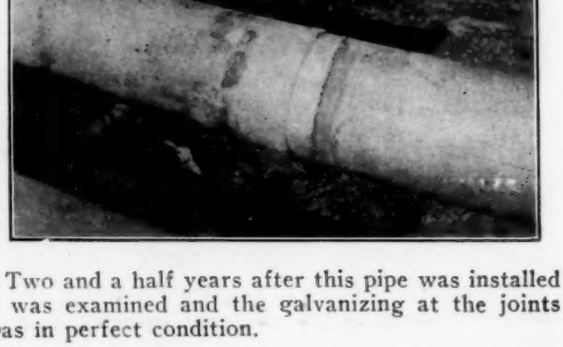


No. 1. The weld before galvanizing, showing where the original galvanizing was burned from the pipe.

No. 2. The asbestos bands in place and the portion to be galvanized thoroughly cleansed. In this picture the portable melting pot can be indistinctly seen in position under the joint.

No. 3. The molten zinc being poured over the pipe.

No. 4. The completed job.



Two and a half years after this pipe was installed it was examined and the galvanizing at the joints was in perfect condition.

Catechism of Central Station Gas Engineering in the United States

Installment No. 15

(Continued from last week)

Means, consisting of a small engine and the necessary train of gearing, are provided to slowly rotate the shaft and attached bundles. The spaces between the slats are very narrow, and thus the gas in passing through the scrubber flows in thin streams over surfaces kept continually wet by dipping into the liquor in the lower part of the shell as the shaft rotates. Water is admitted to the end opposite to that at which the gas enters and is carried by suitable overflows from one compartment to another until it finally leaves the scrubber at the gas inlet end. In this way the foul gas is caused to come in contact first with the strongest liquor, and then, as it passes through the scrubber and its content of ammonia decreases, with liquor of decreasing strength until, the ammonia having been all extracted, clean gas only enters the last compartment, which thus contains pure water.

Since these scrubbers are made with a comparatively large number of compartments it is possible to keep more than one clean and thus run no risk of losing any ammonia, and at the same time have sufficient scrubbing capacity to use only a small quantity of water and produce a correspondingly strong ammoniacal liquor.

Admission of Water to Tower Scrubber

76. Give a description, illustrated with sketches, of some device by which the water admitted to a tower scrubber can be distributed uniformly over the whole surface of the scrubbing material.

Ans. The greatest difficulty to be overcome in securing the even distribution over the whole surface of the scrubbing material, of the water used in a tower scrubber, is found in the small quantity of water which is used in proportion to the amount of surface to be wet. This is especially the case when no power for operating mechanical appliances is available except such as can be obtained from the water to be used. As this is the case in the majority of the gas works in this country, the devices employing outside power will not be considered in this answer.

The principal devices by which distribution is secured by the energy of the water used may be divided into three classes, those in which a constant flow is maintained through fixed orifies, those in which a constant flow is maintained through orifices revolving about the center of the scrubber, and those in which an intermittent flow through fixed orifices is employed.

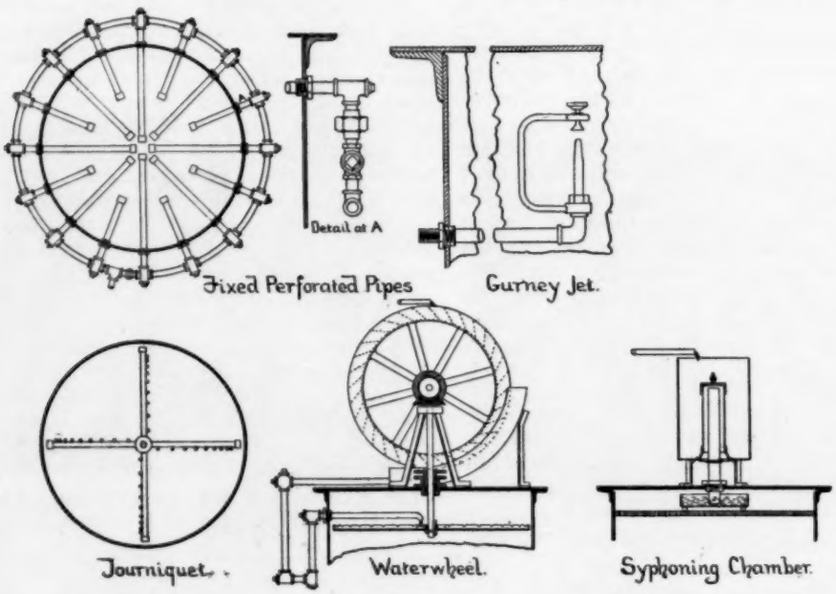
Systems of Fixed Pipes

In the first class belong the systems of fixed pipes inserted at equally distant points around the circumference of the scrubber just below the top head, with long and short lengths alternating, as illustrated in the cut, and pierced with small holes on the lower side through which the water issues. This arrangement is satisfactory when comparatively large quantities of water are used, as in water gas scrubbers or for coal gas scrubbers fed with ammoniacal liquor, but with the small flow required for coal gas scrubbers in which clean water is used, the pressure of the water must be kept so low that a majority of the holes soon stop up and the distribution becomes very uneven. Another device of this class is the Gurney jet, in which a jet of water issuing at a high pressure from a small orifice strikes against an inverted cup, or in some instances a flat plate, fixed a short distance above the orifice, and is broken up by the force of its impact into a fine spray which is scattered over a circular area having the jet as its center. If the area of the scrubber is not too large, one jet, placed at the center, just under the top head, is used, but in very large scrubbers it may be necessary to use several, properly distributed over the area.

Hydraulic Tourniquet System

A device belonging to the second class which is frequently used is based on the same principle as the hydraulic tourniquet lawn sprinklers. It consists of a set of pipes radiating from a central fitting which is arranged so that it can rotate and at the same time be always open to a supply of water under pressure. Each pipe is pierced with holes on one side only, the various pipes being so fastened in the central fitting as to have the holes in all of them pointing in the same direction. When the water is turned on, it issues from the holes and the reaction against the opposite sides of the pipes, which are solid, causes the whole system to revolve. To produce an even distribution over the whole area, the distances between the holes are gradually reduced in going from the center to the outer ends of the arms. In this form of distributor a good distribution can be secured with a smaller number of arms than when the pipes are fixed, and the greater flow through each orifice reduces the tendency for them to clog up, but it still exists to a certain extent. In another form belonging to the same class, the water is run into an overshot water wheel made of heavy tin or galvanized iron and placed on top of the scrubber. This wheel drives the revolving distributor inside of the scrubber by means of bevel gears and a vertical shaft passing through a stuffing box in the head. The distribu-

tor consists of four or six radial arms, each of which is a shallow trough running out of a central trough. In the sides of these troughs notches are made through which the water runs out, the notches being closer together near the outer ends than they are towards the center. Underneath the water wheel is a funnel which catches the water dropping from the buckets. From this funnel a pipe with a syphon in it runs to the inside of the scrubber and delivers the water into the central trough of the distributor, from which it flows into the radial troughs and runs out through the notches. As the troughs are kept in motion as long as the water is flowing, this form of distributor gives a good distribution and is very free from any tendency to get out of order.



Tumbling Barrels and Syphoning Chambers

Devices of the third class consist of arrangements of tumbling barrels or syphoning chambers by means of which a comparatively large quantity of water is flushed into the scrubber at regular intervals. In the apparatus illustrated on the cut, a syphoning chamber is used. The water runs into the chamber continuously in a small stream, but none runs into the scrubber until the level rises above the top of the syphon. When this height is reached, the flow into the scrubber is started and is continued by the syphoning action until the lower end of the syphon is uncovered. The pipe through which the water flows being made large, say 2 in. in diameter, the water is run into the scrubber at a high speed and overflowing from a sealing pan spreads over a wooden tray which is made the full size of the scrubber. This tray is perforated with small holes uniformly distributed over the whole surface, so that the water running through them wets the scrubbing material equally at all points. A small hole should be drilled at the top of the syphon, or an air cock should be attached at this point, to allow the air to escape from the syphon as the chamber fills up.

Object of Washing Process and Temperature Conditions

77. What is the object of the process of washing, or scrubbing, to which coal gas is subjected during its manufacture, and how and under what conditions of temperature should it be carried on to produce the best results?

Ans. The primary object of the process of washing or scrubbing coal gas is the removal from the gas of the ammonia which it contains. But, in all except the smallest works, there is a secondary object to be sought which is as important as the primary object, namely, to carry on the process in such a way that the ammonia be made to combine with, and remove from the gas, the greatest possible amount of carbon dioxide and sulphuretted hydrogen. The attainment of this object relieves the purifiers of much work that would otherwise be thrown upon them, whether they are used to remove both the impurities named or only the sulphuretted hydrogen. In the latter case it is especially important that the ammonia be made to combine to as great an extent as possible with the carbon dioxide, since in this case it is only by such combination that any of this impurity will be removed from the gas.

Effect of Water on Gas

Water, having the property of absorbing ammonia in a volume large as compared with its own volume, and being cheap, is universally used in washers and scrubbers. As the volume of ammonia which a given volume of water can absorb decreases very rapidly with rise in temperature, it is necessary that the temperature of the gas be kept low during the process, a temperature of 60 deg. being that at which it is usually carried on. To secure thorough saturation

of the water and at the same time the complete removal of the ammonia from the gas, it is necessary that there should be intimate contact between the water and the gas and that they should flow through the washers and scrubbers in opposite directions in order that the clean water will meet nearly clean gas, and thus remove from it the last traces of ammonia, while the weak liquor first formed will, as it flows on, come in contact with gas containing more and more ammonia and thus become more and more saturated.

How Complete Saturation of the Ammonia Liquor Is Obtained

To secure the complete saturation of the ammonia with carbon dioxide and sulphuretted hydrogen, it is necessary to wash and scrub the gas with the ammoniacal liquor deposited in the hydraulic main and condensers. This liquor, owing to its having been formed at a comparatively high temperature, contains a large proportion of uncombined ammonia, which will combine with carbonic dioxide and sulphuretted hydrogen when brought into intimate contact with gas containing these substances, after it has been cooled. The hydraulic main and condenser liquor is used in the washer or scrubber into which the gas first enters after leaving the condensers, or if only a single scrubber of the rotary mechanical type is used, this liquor may be run in at about the middle compartment and allowed to flow toward the gas inlet end, clean water being run in at the gas outlet end and the resulting liquor allowed to go through all the compartments, being mixed with the hydraulic main liquor after passing the point at which the latter is admitted.

Details of Ammonia Recovery Process Carried Out Under Best Operating Conditions

78. How should the process of washing and scrubbing coal gas be carried on to make the ammonia combine with the greatest possible amount of carbon dioxide and sulphuretted hydrogen and thus relieve the purifiers of work that they would otherwise be called upon to do?

Ans. In order that the ammonia in coal gas shall be made to combine with the greatest possible amount of carbon dioxide and sulphuretted hydrogen, it is necessary to so present to the gas the ammoniacal liquor formed in the hydraulic main and condensers as to give the uncombined ammonia, which forms a large proportion of the total amount of ammonia in such liquor, an opportunity to combine with the carbon dioxide and sulphuretted hydrogen in the gas.

The way in which this can be done depends upon the equipment of the works in scrubbers. If tower scrubbers are used at least two should be provided, the gas passing first through one and then through the other. In the first one that it enters the gas should be scrubbed with the liquor from the hydraulic main and condensers mixed with the weak liquor from the second scrubber in which clean water is used to remove the last traces of ammonia. If a rotary mechanical scrubber is used, the liquor from the hydraulic main and condenser can be introduced into, say, the middle compartment, where it mixes with the liquor formed in the compartments on the gas outlet end, at which clean water is admitted, and in connection with this liquor is used to scrub the gas it passes through the compartments on the gas inlet end.

In England, where the gas coals contain more sulphur than do those used most extensively in this country and where, consequently, it is more important to make the ammonia combine with all the sulphuretted hydrogen that it can, tower scrubbers and mechanical scrubbers are sometimes used in series, the gas passing first through the tower scrubber, where it meets the hydraulic main and condenser liquor mixed with liquor from the mechanical scrubber, into which it passes after leaving the tower scrubber and which is supplied with clean water at the rate of from one to one and a half gallons per 1,000 cubic feet of gas made.

In places where the cheapest coals contain a comparatively large percentage of sulphur the cost of purification can be considerably reduced by so arranging and handling the apparatus as to take full advantage of the power of the ammonia to combine with sulphuretted hydrogen.

Methods of Preventing Deposition of Naphthalene

79. Describe one or more of the various methods employed to prevent the deposition of naphthalene in a solid state in the mains and esrvices, and give the theory of the method described.

Ans. The various methods employed, or proposed, to prevent the deposition of naphthalene in a solid state in the mains and services may be divided into two general classes—those which remove the naphthalene from the gas at the works by means of some absorbent, and those which consist in adding to the gas vapors of liquids having a solvent action on naphthalene and approximately the same vapor tension as that substance.

Methods of the first class have been adopted quite generally on the continent of Europe and to some extent in Great Britain. In them the gas is washed or scrubbed with an oil which possesses the property of absorbing naphthalene vapor, the process being exactly similar to that by which ammonia is removed from the gas. The operation is usually carried on in a rotary, mechanical scrubber of the "Standard" type, in which either creosote oil, heavy tar oil or anthracene oil is used instead of water. A small amount of benzol, from 3 per cent to 8 per cent by weight, is added to the oil used, to saturate it and thus prevent it from absorbing benzol from the gas and reducing the illuminating power.

Use of Anthracene Oil

According to Dr. Bueb, at Dessau, Germany, an anthracene oil boiling between 480 deg. and 750 deg. F. is used, and 176.4 lb. (19 to 20 gallons) of this oil removed from 706,000 cu. ft. of gas naphthalene to the amount of about 200 grains per 1,000 cu. ft. The capacity of the oil for naphthalene scrubber should follow the tar extractor and work on comparatively hot gas. In some cases, however, two or three compartments of the ammonia scrubber are used. After being saturated with naphthalene the oil can be put in a still and the naphthalene driven off, or it can be chilled, crystallizing the naphthalene, which is then removed by means of a filter press. In either case the oil can be used over again. If working on a small scale it may be more economical to run the saturated oil into the tar tank and sell it as tar.

Use of Naphtha

The frequently employed method of running into the gas as it goes out into the district, naphtha which becomes vaporized and travels along with the gas, belongs to the second class. The naphtha is usually added to the gas at the outlet of the governor, being blown into the gas in a finely divided spray by a small steam jet atomizer. The success of this method depends upon the precipitation of the naphtha in liquid form at the time and place at which the naphthalene is deposited, so that the latter will be dissolved and carried off by the former, and as this does not always occur, the remedy is not always successful.

A modification of the above method, known in England as the Hastings Carburation Process, consists in forming in the gas, as it goes out from the works into the street mains, a mist of oil, the oil used being one that is not volatile at ordinary temperatures. This mist, of very minute drops, is formed by blowing the oil through specially constructed atomizers by means of a portion of the gas which is compressed to a pressure of 75 lb. per square inch. It is found that in this state of minute subdivision some of the oil will remain in the gas until it reaches the farthest point in the district. The conditions which will cause the deposition of naphthalene at any point will also precipitate enough of the oil to dissolve this naphthalene and carry it off as a liquid. It is stated that at Hastings one gallon of oil used in this way for each 166,000 cu. ft. of gas is sufficient to do away with all trouble from naphthalene stoppages, although these begin to show as soon as the process is discontinued.

Much information on the subject of the prevention of deposits of naphthalene in street mains and services can be found in Vols. LXXII to LXXVI of the Journal of Gas Lighting.

Use of Coal Gas Residuals

80. Name some of the useful purposes to which the by-products or residuals of coal gas manufacture are applied.

Ans. Coke: Coke and breeze are used as fuel for manufacturing and domestic purposes.

Retort Carbon: Carbon is used extensively for electrical purposes.

Coal Tar: Coal tar, in its crude state, is chiefly used as a preservative coating for wood and metal, for fuel, and for the manufacture of roofing felt. The distillates of coal tar are many. Among them are benzol, naphtha, benzine, creosote oils, anthracene oils and naphthalene. Benzine and anthracene are used in the manufacture of aniline dyes. Naphtha and benzine are used to enrich gas, as solvents for pigments in paints, and in rubber manufacture. Creosote is used to preserve wood and in the manufacture of carbolic acid. Naphthalene is used as an enricher of gas in so-called "Albo-Carbon" lamps, and to preserve fabrics from moths. The residue remaining after these substances have been driven off is called pitch and is used principally in roofing and in paving concrete.

Uses of Ammoniacal Liquor

Ammoniacal Liquor: From ammoniacal liquor are manufactured sulphate of ammonia, muriate of ammonia (sal-ammoniac) and other ammonia salts, and aqua ammonia. Aqua ammonia is used for cleaning wool and other fibres, in refrigerating and in the manufacture of ice and soaps. Sulphate of ammonia is used as a fertilizer and in manufacturing commercial soda. Sal-ammoniac is used in galvanic batteries and in the arts.

Spent Lime: Spent lime is sometimes used as a fertilizer.

Spent Oxide: Sulphuric acid and cyanogen are obtained from spent oxide.

81. Name some useful purpose, or purposes, to which tar (coal or oil) can be applied, either in or outside the gas works, and describe the method of preparation and employment for such purpose.

Ans. (A) As a paint.

(B) As a sidewalk pavement.

(A) The tar must have less than 1 per cent of water in it to be readily boiled down without the use of special stills. Concentrate the tar by boiling until it will "string" between thumb and forefinger when cooled to 60 deg. Fahr. When ready to use as paint, heat in quantity required for six hours' use, to about 150 deg. Fahr. and stir in benzine in the proportion of one gallon to four of the tar. Apply hot, though as it gradually cools it can be used nearly as well, and sometimes the tar has been thinned as above while cold and used without heating, and has given satisfaction.

Naphtha is sometimes used instead of benzine. Paraffine oil is also employed as a thinner of the tar. Lime is also considered by some a necessary ingredient, but if used as mentioned here, the paint will prove durable and give a hard, smooth surface.

(Sixteenth Installment Next Week)

USE OF BITUMINOUS COAL AS GENERATOR FUEL

(Continued from page 340)

One an eleven-foot U. G. I. set, which lines in to 9 feet internal diameter.

The other, an 8 ft. 6 in. set, which lines in to 6 ft 6 in. internal diameter.

In each case we will assume an active area one foot in width, which active area we have found occurs around the outer periphery of the shell. For the sake of argument, we will assume that the balance of the fire is inactive. The grate area in the larger set figures 63.62 square feet, while that of the smaller set figures 34.9 square feet. In the case of the larger set you will have an inactive area seven feet in diameter or 38.5 square feet, while in the smaller set you will have an inactive area of 4 ft. 6 in. in diameter, or 15.12 square feet. The percentage of inactive area as compared to total grate area will figure 61 per cent in the larger set, while in the smaller set it figures 43.3 per cent. The smaller we would go on sets, the less the percentage of inactive area as compared to total grate area would become. This might seem like a rather crude example, but the writer believes that the reasoning is sound and will drive home the point which has been proved in practice, namely, that with the equipment as we have it at the present time, it is much easier to approach coke capacity with soft coal as generator fuel on small machines than it is on larger machines.

Fourth: One machine was equipped with a revolving spreading distributor, and while the experimental work along this line is not complete, and the work done with this machine with superheated steam and twin generators would form a basis of a complete paper in themselves, the writer does not care to go into this matter in detail at this time. The data secured in these experiments will be embodied in this paper, and we will give here a brief outline of our arrangement to get superheated steam and the connections for twin generators.

In our house our number three and four generators happened to be opposite handed machines, so we took off the dust collectors and elbows on each machine and cross connected the generators. We then put a steam connection in the middle manhole of the superheater on No. 3 machine. During the run the steam was introduced into the superheater of No. 3 machine, passed down through this superheater, up through the carburetor and the hot valve on No. 3 machine was reversed and steam passed down through the reverse steam connection and up through the fire of No. 3 machine. The blue gas made was conducted across the connections made between the generators and into the carburetor and superheater of No. 4 machine, where the oil was introduced. During the blasting period the amount of blast gas for each set was controlled by butterfly dampers in the waste heat boiler stacks of No. 3 and No. 4 boilers. In this case No. 4 generator acted merely as a dust collector, there being no fire in this generator.

To accomplish the twin generator combination we placed tees in the reverse steam connections of each set and connected these tees with a 20-inch steel brick lined pipe. In using saturated steam we used only one carburetor and superheater, namely No. 3 having blanked off No. 4, and also placing a blank in the reverse steam connection of No. 4 machine just above where it was cross-connected to No. 3 machine.

Inasmuch as this paper does not deal directly with superheated steam, twin generators or revolving distributors, we have merely inserted the foregoing to give anyone making a study of tables some idea of how we got our superheat and twin generator effect.

Fifth: We built up the off-take half way up, having the idea of getting a deeper fuel bed. The results were not at all successful, for the blown over fuel increased and the capacity remained the same.

Sixth: Up to last fall all of our experimental work and daily operation had been with coal of various kinds, with little or no thought paid to sizing or preparation. We in the operating end had felt all along that this was a very important phase of the operation, but we, however, were trying every method we knew to find some means to use cheaper fuels, in fact, to actually use boiler house screenings as generator fuel.

The screening tests on different fuels which we have used will be in tables appended to this paper. Last fall, however, it became a question with us as to whether or not we would have to purchase additional sets, or whether by some means we could increase the capacity of the equipment we had. Our make per set on some of our worst coal had dropped as low as 1,000 M. At this stage we put up a forking platform below our coal bunker and all of our coal was forked over a 2-inch fork, and put into a larry to be charged. While this method of cleaning the coal was crude, it gave us enough data to show how important is the use of a fairly large sized coal evenly sized. In table No. 2 we believe this fact has been brought out very clearly. You will note that the gross fuel on the screened coal is from four to six pounds less than with the unscreened coal, and the blown over fuel is from two to two and one-half pounds less. The make per set day is increased approximately 20 per cent with the screened coal.

It soon became apparent that the forking was an expensive method and means to do this automatically were considered. We studied various screening outfits and methods and finally decided to install the Hummer electric vibrating screen. This screen is very simple, takes up a minimum of space, and with it you have no shafts, bearings or gears to contend with. It is very simple to install, we having made installation without shutting down. The screening device requires little or no attention and the maintenance costs on same are very low. With this screen, we get very efficient separation. The writer went into the problem of screening devices very thoroughly and we believe we have selected the best outfit for our particular needs. With this outfit we have screens ranging from ½-inch square mesh up to 3-inch mesh. As yet we have not run as an elaborate system of tests on various size coals as we intend to. We expect to make this the basis of further test work, balancing from all angles of the cost standpoint, to decide just how much of the lump coal we can afford to reject as boiler house fuel and

how far we will have to go to give us the highest efficiency in general with the least cost per M. It must be remembered that all of the fuel going to this screen has been paid for at the lump price and any fuel that is rejected through the screen must go to the boiler house and must be charged there at current price of boiler house fuel. Therefore, the ultimate cost of the lump coal must be necessarily at a price higher than the original purchase price to make up this difference. Thus far we have found that coal screened over a 2-inch screen has given us most satisfactory results. The rejection with this size screen is 8 per cent when taking our Illinois coal fresh from cars.

At this point we desire to lay particular stress upon the method of handling bituminous coal and sizing of same before the generator. We have found that it is absolutely essential to avoid breakage as far as possible in the coal from the time it leaves the mines until it finally reaches the generator. We have also found that from the physical characteristics of Illinois and Indiana coals that they will not stand much handling, and we have gone to the point of avoiding as far as possible putting these coals in the stock pile. In other words, as far as feasible, we are using this coal direct from cars. We also lay considerable emphasis among our men who are unloading and handling this coal upon the fact that we desire as little breakage in handling as possible, and by this we mean that we instruct them to keep all track hoppers and bins as well filled as possible at all times. All of our coal which goes to the water gas plant is dropped into a track hopper and from there is conveyed to the bunker, as stated under description of apparatus. With this layout, and to avoid considerable handling, it was absolutely necessary that we get a particular type of railroad car, namely, a center dump hopper car, and we have finally convinced our mines, and the railroad company, that this is the only type of equipment we want. With this equipment we avoid shoveling and excessive handling of the coal. We have tried all sorts of devices to prevent breakage and are always willing and ready to try out any new ideas along these lines, as we feel it is one of the most important things we have to contend with.

We also find that Illinois and Indiana coals do not stand up very well on storing, and that they weather quite rapidly. We have found that since Illinois and Indiana coal with large amount of fines in it and the higher sulphur content is open to the danger of spontaneous combustion, it is best in storing, to store lump size coal. The fine coal carries most of the impurities.

All during our test work and during our practical operation we found that as soon as we get very much fines in the fires, our efficiencies drop off; in other words, our fuel per M. goes up, make per set day comes down, and oil per M. goes up. This fact was brought out very noticeably in some of our test work, where we were using coal from stock, the sizing of which varied quite materially. Most of our special test work was divided into eight hour periods and from data which we kept the foregoing statements were brought home in a forcible manner, as we found that this coal would sometimes change within the short interval of an hour or so, and the results obtained from one period to another would vary as the amount of fines in the coal varied.

From observation our theory of the effects of excessive fines in the generator fire is as follows: When this fine coal is charged into the generator it forms a blanket over the top of the fire, which is absolutely non-uniform in character. The action of the blast and steam tends to break through the weakest points, forming large channels in the fire and considerable less active area. With this condition there is considerable secondary combustion in the top of the generator, and in order to keep the top of the generator and hot valve cool it becomes necessary to use excessive steam. With this condition of a generator fire the amount of blue gas per square foot of grate area falls off, the quality of the blue gas made decreases in value and the amount of the products of combustion left in the set after a blow become greater in proportion to make per run than if the set were making at a greater capacity. From the foregoing facts it will be readily seen that your efficiencies will drop off quite materially.

From our present operation while using screened coal, we find that our air per M. has been reduced from around 2,100 cubic feet per M. to approximately 1,400 cubic feet per M. and our steam from 70 lbs. to 38 lbs. per M. Where we used to have considerable trouble with burning out of generator tops and hot valves, we do not believe that under present conditions we are troubled in this way any more than we would be with coke operation. Another source of trouble which we had when using fine coal was the sticking of the various blast and hot valves. This condition has been practically eliminated since we are using screened coal.

One of the most valuable adjuncts to a water gas set using soft coal as generator fuel is a waste heat boiler. In our early experience with waste heat boilers we learned, not from test work, but from actual experience, that it was to our advantage to put both gases through the boilers. This fact has since been proved by actual experiments which are shown by table attached. In our early stages of operation, the one thing that bothered us most was the plugging up of the tubes of the boilers with a heavy carbon deposit. The temperature at outlet of the waste heat boilers during this stage often went as high as 1,000 degrees F. after a short interval of running. As is generally known, all U. G. I. waste heat boiler installations are equipped with what is known as tertiary blast connection in the top of the superheater. In ordinary coke operation this tertiary blast is used merely to burn out the boiler at stated intervals. This is not so with soft coal operation, as the tertiary air is used each and every cycle, due to the fact that there is by far more combustible gases given off during the blasting period than is needed to heat the checker chambers. From this fact it can be seen that it is almost impossible to blow the carburetor cold. The careful manipulation of the carburetor and tertiary air was

brought out very forcibly to us in a system of tests run along these lines at our plant and with the aid of engineers under the direction of Mr. W. H. Gartley of the U. G. I.

When we originally started waste heat boiler operation we set our tertiary air for what we thought was the average amount needed. This setting was not changed unless generator fuel changed quite materially. With this method of operation, we found it necessary to take a boiler off the line every eight to ten days for turbining. The turbining required two days and from this it can be seen that we lost from 20 to 25 per cent of the service of the boiler in an eight to twelve-day period. In turbining boilers at this time we had gotten as high as 4,500 pounds of carbon borings out of a single boiler. This method was costly as well as exceedingly hard on the boilers. The average boiler horse power per boiler hour was about 175.

During the early months of 1922 there was considerable theory advanced as to the relative value of using only blast gases through the boilers, as against both gases. The theory was that of the steam generated in the waste heat boiler, 88 per cent was due to the blast gases and the balance to the make gases. By using blast gases only one is enabled to keep the boiler on the line considerably longer than when using both gases. On September 1, 1922, we started with all boilers clean and put only blast gases through them. We ran this way from September 1 to September 20 and did not attempt any adjustment of tertiary air. Our average boiler horse power during this period was approximately 100.

About this time engineers under Mr. Gartley were out to work with us on this problem. After considerable analysis of stack gases and also observations of the waste heat boiler stacks during the blasting period, it was decided that there was no average condition by which we could set the tertiary air. We accordingly rigged up a system of levers connected with the tertiary blast damper by means of cables leading to a central station. By removing a portion of the tile roof one man at this station had a clear vision of the top of the waste heat boiler stacks. His duty was to adjust the butterfly damper so that just enough air was admitted to clear up the thick smoke when insufficient air was used.

AVERAGE SCREENING TESTS OF FUELS USED.

Kind of Fuel	Fourth Vein Ind. Lp. from Stock	Jackson County, Ill., from Cars	Jackson County, Ill., from Stock	Jackson County, Ill., Scrgs. (Screened)
Over 1⅜" Screen, %	31.5	49.2	36.6	...
Over 1" Screen, %	13.9	16.0	33.9	...
Over ½" Screen, %	18.2	12.8	6.5	76.3
Through ½" Screen, %	36.4	22.0	23.9	23.7

APPROXIMATE ANALYSIS OF FUELS USED.

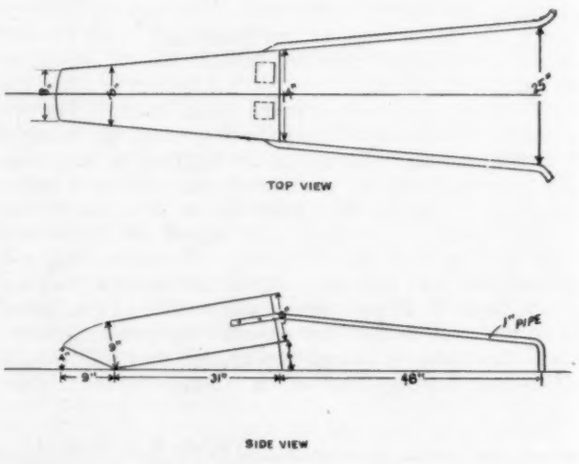
Kind of Fuel	Fourth Vein Ind. Lump	Jackson County, Ill., Lump	Chilton Seam, W. Va., Lump	Jackson County, Ill., Screened Scrgs.
H_2O	12.95	6.95	1.35	6.90
Vol. Matter	29.83	33.40	35.76	33.70
Fixed Carbon	47.55	52.70	54.13	42.28
Ash	9.67	7.25	8.76	11.12

TABLE I, SHOWING EFFECT OF FIRE LEVELS IN THE GENERATOR. USING UNSCREENED COALS.

Test	1	2	3	4	5
Position of Top of Fire Air/M..	7,000/M low pressure about 1½" below	8,500/M high fires up to off-take	7,000 air/M high fires up to off-take	7,000 air/M fires 1" below off-take	
Kind of Coal	Jackson County, Illinois (Gus Blair) Lump from Cars.				
Pounds of Fuel/M	45.81	48.18	47.59	47.62	....
Blown Over Fuel	3.27	5.18	4.73	4.32	....
Net Fuel/M	42.54	43.00	42.86	43.30	....
Oil/M	3.34	3.87	3.76	3.33	....
Make/Set Day	1,438 M	1,421 M	1,445 M	1,486 M	....
No. of Days of Test	21	3	5	6	....

An average of four days of this operation with blast gas only going through the boilers increased the average boiler horse power developed from 100 to 162.6. We then put both gases through the boilers and the average horse power developed per hour was 225 for 14 days (see table No. 3). This showed that the finished gas was developing more horse power than was originally estimated. Some of this additional horse power no doubt came from the excess steam we were using in the generator as we were using unscreened coal at this time and our steam per M. ran as high as seventy pounds. The remainder was probably developed on the blow due to the combustion of some of the light oils in the tar deposited on the tubes during the run. Simul-

taneous samples of the blast gas taken on the inlet and outlet of the boiler showed as much as 2 per cent decrease in oxygen, showing that combustion was taking place in the tubes. All our figures show in favor of both gases through the boiler. By the foregoing method of adjustment of tertiary air we are now able to run a boiler from 20 to 24 days on the average, and the boiler is off the line about one and one-half days. The turbining is apparently easier than in the early stages of our operation and the amount of boring removed from the tubes is approximately one-third of what it originally was. The temperature at the outlet of the waste heat boiler under present operation will rarely average over 750 deg. to 800 deg. when it is taken off the line for cleaning after a 20 to 24 day run. We believe that we are very conservative when we say that in our particular plant each waste heat boiler returns us the equivalent of at least fifteen tons of boiler house fuel per day. The amount of horse power developed in the waste heat boilers is directly affected by the gen-



COAL DISTRIBUTOR FOR CHARGING GENERATOR COAL.

TABLE II, SHOWING THE EFEECT OF SCREENING GENERATOR COAL.
CONDITIONS UNDER WHICH GAS WAS MADE ARE THE SAME IN EACH CASE.

Kind of Fuel	Jackson Co., Ill., from Cars, and Screened Over 2" Screen	Jackson Co., Ill., from Cars, Unscreened	Jackson Co., Ill., from Cars, Screened Over 2" Screen	Jackson Co., Ill., Over 2" Screen
Gross Fuel/M	42.96	46.22	40.42	41.19
Blown Over Fuel/M	2.82	4.11	1.66	1.86
Net Fuel/M	40.14	42.11	38.76	39.33
Oil/M	3.15	3.51	3.29	3.38
Make/Set Day	1,873 M	1.573 M	1,866 M	1,825 M
No. of Days of Test	11	4	14	10
B. t. u.	550	555	555	558
Oil Efficiency	100,050	93,930	98,800	97,300

Note: Nos. 1, 2, 3—Oil 32-36 deg. Be'. No. 4—Oil 24-28 deg. Be'. Oil efficiency figured on 300 Blue Gas and 70 cu. ft. of oil/gallon.

TABLE No. III.

	Blast Gas Only Tertiary Air Unadjusted	Blast Gas Only Tertiary Air Adjusted	Both Gases Tertiary Air Adjusted
Average W. H. Boiler H.P. Developed	100	162.6	225
Average Stack Temperature No. 1 Boiler	776	786	805
Average Stack Temperature No. 2 Boiler	643	737	757
Average Stack Temperature No. 3 Boiler	730	746	734
Number of Days Run	3	4	14
Average Corrected Gas Per Day	5,503	5,606	5,462
Make Per Set Day	1,374	1,401	1,366
Make Per Set Day Per Sq. Ft. Grate	21.7	22.1	21.5
Make Per Running Hour	64,900	67,100	64,200
Average Time of Clean	1.59	1.67	1.71
Generator Fuel Per M	42.90	44.50	44.13
Coke Recovered Per M	2.10	2.40	2.85
Net Generator Fuel Per M	40.80	42.0	41.28
Oil Per M	3.18	3.03	3.20
Average B. t. u.'s	543	545	544
B. t. u. Per Gal. (300 B. t. u. Blue Gas)	97,400	101,800	97,300
Boiler Fuel Per M	25.80	21.90	21.71

erator fuel per M. We have found that by the use of various coals of all sizes that as soon as the generator fuel per M. increased the horse power developed in the waste heat boilers increased, and vice versa. We have developed an average as high as 250 boiler horse power per hour on Indiana coals. In terms of steam developed per M. of gas made our figure has varied from 100 pounds to 150 pounds. We believe that in a plant of any size using soft coal as generator fuel that it is gross waste not to be equipped with waste heat boilers. Waste heat boilers are a decided saving even with coke operation, but with soft coal as generator fuel the steam return is from two to three times as much as with coke operation. In the study of the summary of tests run at our plant using single and twin generators, together with a revolving distributor on one machine, and also using superheated steam during time of the test, we have attached to this report a table showing a comparison of results of the test work as against regular operation.

In our regular operation we have shown runs on Indiana coal and on our Illinois coal, both screened and unscreened. The use of superheated steam, together with the stirring device, showed practically little or no saving for us when we were using unscreened coal, and in no case a saving over our present operation with screened coal.

We believe that there is a considerable field for research work with superheated steam, superheated blast and some mechanical means whereby the fire could be kept open and the voids filled at all times. With soft coal what we want to do is find some method by which more of the fuel bed can be kept alive. While the recent paper on superheated steam and superheated blast presented at the Illinois Gas Association meeting, by Mr. W. M. Gartley, really showed negative results, we in the operating end have not yet lost faith and we believe that this idea will be made the basis for further research work.

In preparing this paper the writer has attempted to give you facts as obtained from regular practical operation over a long period of time. The field which we have covered in the use of soft coal as generator fuel has been so vast that the writer has felt it necessary to in order to prepare a paper of rea-

SUMMARY OF RESULTS ON SOFT COAL OPERATION.

COAL PRODUCTS MANUFACTURING COMPANY

4 No.	No. of Days Run	Kind of Generator Fuel Used	Make per Set Day	Gross Fuel/M	Blown Over Fuel/M	Net Fuel Per M	Oil Per M	Oil Efficiency
1	32	Rex. Lp. from Stock	1,465	39.39	1.80	37.59	3.19	100,000
2	10	Rex. Lp. ½ from Stk., ½ from Cars	1,348	38.83	1.66	37.17	3.53	93,200
3	8	Ind. Lp. from Cars	1,237	47.52	1.64	45.89	3.53	95,300
4	8	Rex. ½ Lp. and ½ R/M	1,271	42.72	1.37	41.33	3.39	95,300
5	7	Ind. Lp. from Stock	1,310	52.55	2.12	50.37	3.35	95,600
6	5	Richardson Lp.	1,061	53.11	2.22	50.89	3.39	95,040
7	23	Ind. Lump	1,156	53.55	2.13	51.47	3.33	96,370
8	4	Rex Run of Mine	1,148	48.73	1.73	47.00	3.47	94,200
9	5	Gus Blair Lump	1,174	50.62	3.04	47.58	3.29	97,020
10	20	Ind. Lp., 90% Stk., 10% Cars	1,158	53.49	3.80	49.69	3.52	92,400
11	21	Gus Blair Lump fr. Cars	1,438	45.81	3.27	42.54	3.34	94,990
12	10	Gus Blair Screened Screenings	1,082	50.28	3.24	47.04	3.66	89,800
13	2	Gus Blair Scrgs.	985	60.84	3.02	57.82	3.21	97,200
14	4	Gus Blair Lp. fr. Cars	1,319	44.47	2.81	41.66	3.36	92,200
15	10	Ind. Lump from Stock	1,123	52.79	3.99	48.80	3.99	87,900
16	3	Gus Blair Lump from Cars	1,421	48.18	5.18	43.00	3.87	85,400
17	5	Gus Blair Lp., 40% Cars	1,445	47.59	4.73	42.86	3.71	86,430
18	3	Gus Blair Lp., 90% Cars	1,370	49.88	4.49	45.39	3.84	84,900
19	9	Gus Blair Lp., Cars	1,411	47.47	3.69	43.80	3.47	91,000
20	6	Gus Blair Lp., Cars	1,486	47.62	4.32	43.30	3.33	95,180
21	4	Gus Blair Lp., 68% Cars	1,456	50.14	5.23	44.91	3.26	96,400
22	9	Rex Lump (2")	1,659	39.47	2.56	36.91	3.45	92,590
23	11	Gus Blair Lump (2")	1,873	42.96	2.82	40.14	3.15	100,050
24	4	Gus Blair Lump Unscreened	1,573	46.22	4.11	42.11	3.51	93,930
25	14	Gus Blair Lump (2")	1,866	40.42	1.66	38.76	3.29	98,510
26	10	Gus Blair Lump (2")	1,825	41.19	1.86	39.33	3.38	97,100

REMARKS:

Nos. 1-5—7,000 cubic feet of air per minute.
Nos. 6-10—Fires 1½' below off-take—7,000 cu. ft./minute.
Nos. 11, 12, 14—Low fires about 1½' below off-take—7,000 cu. ft. air/minute.
No. 13—Twin Generator Layout which is conducive of low oil results as percentage of diluents is reduced.
No. 15—Fires near off-take—7,000 c. f. air.
No. 16—High fires and high blast—8,500 cu. ft. of air/minute.
Nos. 17-18—Carburetor found to be badly plugged.
Nos. 19, 20, 21, 22—Carburetor clean, fires 1" below off-take, 7,000 cu. ft. air/minute.
Nos. 23-24—1 to 2 minute blow run after coaling—7,000 cu. ft. of air/minute.
No. 25—Oil used 32-36 deg. Be' Fire 1' below off-take—Air 6,000 c. f./min. 1 min. blow run into holder after coaling (Checkerless carburetor and high pressure oil).
No. 26—Oil used 24-26 deg. Be' Fire 1' below off-take—Air 6,000 c. f./min. 1 min. blow run into holder after coaling (Checkerless carburetor and high pressure oil).

Study of Summary of Tests
Coal Products Manufacturing Company, Joliet, Illinois.

		PREVIOUS TO ALL TESTS Feb. 1 to 6, inc., 1923 Actual Results Obtained	TEST NUMBER ONE Actual Results of Test	TEST NUMBER ONE Corrected to 550 B.t.u.	TEST NUMBER ONE Corrected to 550 B.t.u. & 15% N_2
1	Nos. of Sets Operating	1-2-3-4-5		3 & 4	
2	Fire in Generator No.	1-2-3-4-5		3	
3	Operating Stirrer on No. 3 Set	No		Yes	
4	Kind of Steam Used	Saturated		Superheated	
5	Oil in Carburetor No.	1-2-3-4-5		4	
6	Kind of Purge at End of Run	Blast		Blast	
7					
8	Nitrogen % Volume	Est. 15.0	15.8	15.76	15.0
9	Oil Gas % Volume	21.7	21.3	21.40	21.2
10	Blue Gas (by Difference) % Volume	63.3	62.9	62.84	63.8
11					
12	Make per Set Day, M c. f.	1,087	1,385	1,388	1,367
13	Make per Running Hour, c. f.	51,200	67,000	67,200	66,200
14	Make per Run, c. f.	4,650	4,950	4,960	4,890
15	Make per Sq. Ft. per Day, c. f.	17,100	21,800	21,840	21,540
16	Blue Gas (Nitrogen free) Make per Set Day, M c. f.	688	871	872	872
17	Kind of Coal Used		Fourth Vein Ind.	Lp. from Stock	
18	Net Fuel Used, Lbs. per M Make Gas	52.84	52.09	51.99	52.8
19	Net Dry Fuel Used, Lbs. per M Make Gas		43.02	42.94	43.6
20	Net Combustible Used, Lbs. per M Make Gas		38.32	38.25	38.8
21	Net Fuel Used, Lbs. per M Blue Gas				
22	Net Dry Fuel Used, Lbs. per M Blue Gas				
23	Net Combustible Used, Lbs. per M Blue Gas				
24	Oil per M	3.34	3.27	3.29	3.26
25	B.t.u. per Cu. Ft.	550	548	550	550
26	Oil Efficiency				
27	Total W. H. Boiler H.P. Developed (Clean Boilers)	216	210	210	210
28	H.P. Developed per M Make Gas	4.22	3.14	3.13	3.17
29	Steam Used, Lbs. per M Make Gas				
30	Steam Used in H.P. per M Make Gas	2.34	1.77	1.76	1.79

		TEST NUMBER TWO Actual Results of Test	TEST NUMBER TWO Corrected to 550 B.t.u.	TEST NUMBER TWO Corrected to 550 B.t.u. & 15% N_2	TEST NUMBER THREE Actual Results of Test	TEST NUMBER THREE Corrected to 550 B.t.u.	TEST NUMBER THREE Corrected to 550 B.t.u. & 15% N_2	TEST NUMBER FOUR Actual Results of Test	TEST NUMBER FOUR Corrected to 550 B.t.u.	TEST NUMBER FOUR Corrected to 550 B.t.u. & 15% N_2
1	Nos. of Sets Operating		No. 3 Alone			4 & 3			3 & 4	
2	Fire in Generator No.		3			4			3 & 4	
3	Operating Stirrer on No. 3 Set		Yes			No			Yes	
4	Kind of Steam Used		Saturated			Superheated			Superheated	
5	Oil in Carburetor No.		3			3			4	
6	Kind of Purge at End of Run		Blast			Steam			Steam	
7										
8	Nitrogen % Volume	16.7	16.65	15.0	21.70	21.3	15.0	9.1	9.1	15.0
9	Oil Gas % Volume	24.0	24.20	23.8	27.2	28.5	27.8	19.5	19.3	20.7
10	Blue Gas (by Difference) % Volume	59.3	59.20	61.2	51.1	50.2	57.2	71.4	71.6	64.3
11										
12	Make per Set Day, M c. f.	1,278	1,282	1,240	1,200	1,224	1,071	2,150	2,144	2,390
13	Make per Running Hour, c. f.	59,200	59,400	57,400	57,900	59,100	51,700	102,800	102,500	114,300
14	Make per Run, c. f.	4,400	4,410	4,260	4,790	4,880	4,270	7,830	7,810	8,710
15	Make per Sq. Ft. per Day, c. f.	20,100	20,170	19,560	18,900	19,270	16,870	16,900	16,850	18,790
16	Blue Gas (Nitrogen free) Make per Set Day, M c. f.	758	759	759	613	614	613	1,535	1,535	1,537
17	Kind of Coal Used									
18	Net Fuel Used, Lbs. per M Make Gas	58.74	58.58	60.6	48.12	47.16	53.9	58.00	58.17	52.2
19	Net Dry Fuel Used, Lbs. per M Make Gas	50.54	50.40	52.2	39.59	38.80	44.4	49.49	49.64	44.5
20	Net Combustible Used, Lbs. per M Make Gas	45.04	44.91	46.5	33.39	32.72	37.4	44.27	44.40	39.8
21	Net Fuel Used, Lbs. per M Blue Gas									
22	Net Dry Fuel Used, Lbs. per M Blue Gas									
23	Net Combustible Used, Lbs. per M Blue Gas									
24	Oil per M	3.69	3.72	3.66	4.18	4.39	4.28	3.00	2.97	3.19
25	B.t.u. per Cu. Ft.	547	550	550	529	550	550	553	550	550
26	Oil Efficiency									
27	Total W. H. Boiler H.P. Developed (Clean Boilers)	264	264	264	191	191	191	272	272	272
29	Steam Used, Lbs. per M Make Gas	4.46	4.44	4.60	3.30	3.23	3.70	2.64	2.65	2.38
29	Steam Used, Lbs. per M Make Gas									
30	Steam Used in H.P. per M Make Gas	1.82	1.81	1.87	1.90	1.86	2.12	2.07	2.08	1.86

sonable length to eliminate considerable of the minor details which we have encountered. The facts stated, and the measurements given on data sheets, we feel are absolutely accurate, as our plant is equipped with the most modern means of measuring all quantities which enter into this discussion. Our gas is all measured through both a Thomas electric meter and a rotary meter which are checked for accuracy at stated intervals. The B. T. U. of our gas is measured by a Thomas recording calorimeter, which is checked daily against the flow calorimeter. Coal going to the generator is weighed both over a track scale and then on the larry scales in the water gas plant. Our coal stocks have been balanced frequently with little or no discrepancies. All of our oil is actually metered and we take a physical inventory three times a week and the first of each month. We have never had any wide discrepancies in oil.

Study of Summary of Tests

Coal Products Manufacturing Company, Joliet, Illinois.

		—TEST NUMBER FIVE—			TEST NUMBER SEVEN			TEST NUMBER EIGHT		
		Actual Results of Test	Corrected to 550 B.t.u.	Corrected to 550 B.t.u. & 15% N_2	Actual Results of Test	Corrected to 550 B.t.u.	Corrected to 550 B.t.u. & 15% N_2	Actual Results of Test	Corrected to 550 B.t.u.	Corrected to 550 B.t.u. & 15% N_2
1	Nos. of Sets Operating		3			3 & 4			3 & 4	
2	Fire in Generator No.		3 & 4			3 & 4			3	
3	Operating Stirrer on No. 3 Blast		Yes			Yes			Yes	
4	Kind of Steam Used		Saturated			Superheated			Superheated	
5	Oil in Carburetor No.		5			4			4	
6	Kind of Purge at End of Run		Blast			Steam			Steam	
7										
8	Nitrogen % Volume	13.8	13.8	15.0	13.9	13.95	15.0	20.5	20.3	15.0
9	Oil Gas % Volume	21.0	21.1	21.3	19.9	19.56	19.8	21.9	22.7	21.4
10	Blue Gas (by Difference) % Volume	65.2	65.1	63.7	66.2	66.50	65.2	57.6	57.0	63.6
11										
12	Make per Set Day, M c. f.	2,308	2,310	2,362	2,540	2,530	2,580	1,890	1,912	1,710
13	Make per Running Hour, c. f.	111,700	111,800	114,600	123,400	122,900	125,400	87,100	88,100	78,800
14	Make per Run, c. f.	8,750	8,760	8,960	8,410	8,380	8,550	5,130	5,190	4,640
15	Make per Sq. Ft. per Day, c. f.	18,150	18,170	18,590	19,970	19,900	20,300	29,720	30,080	26,900
16	Blue Gas (Nitrogen free) Make per Set Day, M c. f.	1,505	1,504	1,505	1,681	1,682	1,682	1,089	1,090	1,088
17	Kind of Coal Used				Jackson County, Ill. (Gus Blair) Lump					
18	Net Fuel Used, Lbs. per M Make Gas	48.16	48.11	47.05	42.64	42.80	41.95	35.42	35.0	39.10
19	Net Dry Fuel Used, Lbs. per M Make Gas	41.22	41.18	40.25	38.96	39.11	38.33	32.38	32.0	35.77
20	Net Combustible Used, Lbs. per M Make Gas	36.76	36.72	35.90	35.59	35.72	35.00	29.76	29.4	32.86
21	Net Fuel Used, Lbs. per M Blue Gas									
22	Net Dry Fuel Used, Lbs. per M Blue Gas									
23	Net Combustible Used, Lbs. per M Blue Gas									
24	Oil per M	3.23	3.24	3.28	3.06	3.01	3.05	3.37	3.50	3.30
25	B.t.u. per Cu. Ft.	549	550	550	554	550	550	538	550	550
26	Oil Efficiency									
27	Total W. H. Boiler H.P. Developed (Clean Boilers)	301	301	301	296.5	296.5	296.5	171.5	171.5	171.5
28	H.P. Developed per M Make Gas	2.69	2.69	2.63	2.40	2.41	2.36	1.97	1.95	2.18
29	Steam Used, Lbs. per M Make Gas									
30	Steam Used in H.P. per M Make Gas	1.88	1.87	1.83	1.65	1.66	1.62	1.40	1.38	1.55

		PREVIOUS TO ALL TESTS Feb. 20 to 25, inc., 1923	14 DAY RUN in February, 1924			10 DAY RUN 5 Days in February 5 Days in March, 1924		
		Actual Results Obtained	Actual Results of Test	Corrected to 550 B. t. u.	Corrected to 550 B.t.u. & 15% N_2	Actual Results of Test	Corrected to 550 B. t. u.	Corrected to 550 B.t.u. & 15% N_2
1	Nos. of Sets Operating	1-2-3-5		1-2-4-5			1-2-4-5	
2	Fire in Generator No.	1-2-3-5		1-2-4-5			1-2-4-5	
3	Operating Stirrer on No. 3 Set	Yes						
4	Kind of Steam Used	Saturated		Saturated			Saturated	
5	Oil in Carburetor No.	1-2-3-5		1-2-4-5			1-2-4-5	
6	Kind of Purge at End of Run	Blast		Blast			Blast	
7								
8	Nitrogen % Volume	Est. 15.0	18.0	18.2	15.0	18.0	18.2	15.0
9	Oil Gas % Volume	21.6	21.4	20.9	20.1	22.0	21.3	20.5
10	Blue Gas (by Difference) % Volume	63.4	60.6	61.0	64.9	60.0	60.5	64.5
11								
12	Make per Set Day, M c. f.	1,212	1,866	1,857	1,786	1,845	1,812	1,732
13	Make per Running Hour, c. f.	57,450	86,510	86,095	82,783	86,093	85,495	81,813
14	Make per Run, c. f.	5,325	8,583	8,540	8,211	8,327	8,269	7,913
15	Make per Sq. Ft. per Day, c. f.	19,050	29,300	29,200	28,100	28,700	28,600	27,400
16	Blue Gas (Nitrogen Free) Make per Set Day, M c. f.	769	1,131	1,113	1,159	1,095	1,096	1,117
17	Kind of Coal Used	Jackson Co., Ill.	Jackson County, Ill. (Gus Blair) Lump over 2″ Screen					
18	Net Fuel Used, Lbs. per M Make Gas	47.24	38.76	38.95	40.50	39.33	39.61	41.29
19	Net Dry Fuel Used, Lbs. per M Make Gas							
20	Net Combustible Used, Lbs. per M Make Gas							
21	Net Fuel Used, Lbs. per M Blue Gas							
22	Net Dry Fuel Used, Lbs. per M Blue Gas							
23	Net Combustible Used, Lbs. per M Blue Gas							
24	Oil per M	3.32	3.29	3.22	3.09	3.38	3.27	3.15
25	B. t. u. per Cu. Ft.	550	555	550	550	558	550	550
26	Oil Efficiency							
27	Total W. H. Boiler H.P. Developed (Clean Boilers)	235	Est. 200	200	200	Est. 200	200	200
28	H.P. Developed per M Make Gas	4.09	2.31	2.29	2.38	2.32	2.34	2.45
29	Steam Used, Lbs. per M Make Gas							
30	Steam Used in H.P. per M Make Gas	2.04	1.12	1.13	1.20	1.16	1.17	1.22

Current Market Prices

COALS (By Courtesy of Coal Age)

A. Bituminous.

(Spot prices, F. O. B., mines, net tons).

High Volatile, Eastern	Market	Price
Pool 54-64 (Gas Standard))	New York	$1.40 to $1.65
Pittsburgh screened gas	Pittsburgh	2.35 to 2.50
Pittsburgh gas, mine run	Puttsburgh	2.25
Kanawha lump	Columbus	2.40 to 2.70
Kanawha mine run	Columbus	1.50 to 1.80
West Virginia lump	Cincinnati	2.00 to 2.50
W. Virginia gas mine run	Cincinnati	1.25 to 1.50
Midwest		
Indiana 4th vein lump	Chicago	2.75 to 3.00
Indiana 4th vein mine run	Chicago	2.25 to 2.50
South and Southwest		
Big Seam lump	Birmingham	2.50 to 2.75
Big Seam mine run	Birmingham	1.75 to 2.25
Southeast Kentucky lump	Louisville	2.25 to 2.50
Southeast Kentucky mine run	Louisville	1.40 to 1.85

B. Anthracite.

(Spot prices F. O. B. mines, gross tons),

Market	Freight rates	Independent	Company
Egg New York	$2.34	$7.75 to $8.25	$8.25 to $8.65
Egg Philadelphia	2.39	8.25 to 9.40	8.60 to 8.65
Egg Chicago (net tons)	5.06	7.59 to 7.81	7.65 to 7.75

COKE (By Courtesy of Iron Trade Review).

Connellsville, furnace	$3.75 to $4.00
Wise County, furnace	4.25 to 5.50
Alabama, furnace	5.00 to 6.00
Foundry, Newark, N. J., del.	10.91
Foundry, Chicago, ovens	12.50
Foundry, Boston, delivered	12.50
Foundry, St. Louis	12.50
Foundry, Granite City, Ill.	12.50
Foundry, Alabama	5.00 to 6.50

PETROLEUM (By Courtesy of Oil, Paint & Drug Reporter)

(Prices at wells, per bbl.)

Pennsylvania—Ohio—West Virginia.	
Cabell, West Virginia	$2.20
Corning, Ohio	2.15
Lima	2.28
Pennsylvania	4.00 to 4.50
Wooster, Ohio	2.15
Indiana—Illinois.	
Illinois	2.07
Indiana	2.08
Oklahoma—Kansas.	
Healdton	.90
Mid-continent (low gravity)	1.25
Gulf Coast.	
Gulf Coast, Grade A	$2.00
Gulf Coast, Grade B	1.70

GAS OILS.

Gas Oil, Bayonne, bulk gal.	5¼c
Gas Oil (32-36) Illinois-Indiana, gal.	5.50 to 5.75c
Gas Oil (32-36) Oklahoma, gal.	3 to 3¼c
Gas Oil (32-36) Gulf Coast, gal.	4½ to 5 c

PIPE AND FITTINGS—CAST IRON GAS PIPE.

(By Courtesy Iron Trade Review.)

Four-inch, Chicago	$66.20 to $67.20
Six-inch and over, Chicago	62.20 to 63.20
Four-inch, Birmingham	57.00 to 58.00
Six-inch and over, Birmingham	53.00 to 54.00
Four-inch, New York	70.60 to 71.60
Six-inch and over, New York	65.60 to 66.60
Standard fittings, Birmingham, base	115.00

6 to 24-inch, base; over 24-inch, plus $20; 4-inch, plus $20; 3-inch, plus $20.

BY-PRODUCTS

(By Courtesy of Oil, Paint and Drug Reporter)

Ammonia aqua, 16 deg. drums lb.	5 to 5¼c
Ammonia aqua, 20 deg. drums lb.	6¼ to 6½c
Ammonia aqua, 26 deg. drums lb.	6¾ to 7 c
Ammonia squa, anhydrous cylinder, lb.	30 to 36 c
Ammonium sulphate, bulk F. O. B. Works, per 100 lbs.	$2.75 to $2.85
Potash prussiate, yellow casks, lb.	19 to 19½c
Potash prussiate, red casks, lb.	42 to 45 c
Soda prussiate, yellow casks, lb.	13 to 13½c
Soda sulphocyanide, barrels, lb.	45 to 55 c

COAL TAR BASIC PRODUCTS.

(By Courtesy of Oil, Paint and Drug Reporter)

Benzol C. P. tanks, works, gal.	25 to 30c
Benzol, drums, gal.	30 to 35c
Benzol, 90% tanks, works, gal.	23 to 28c
Benzol, 90% drums, gal.	28 to 33c
Napthalene, flake, barrels, lb.	6 to 7c
Napthalene, crushed bags, lb.	5½ to 6c
Solvent Naphtha, water white works, gal.	28c
Solvent Naphtha, drums, works, gal.	33c
Solvent Naptha, Crude Tanks, works, gal.	25c
Solvent Naphtha, drums, works, gal.	30c
Toluene, C. P. tanks, works, gal.	31c
Toluene C. P. drums, works, gal.	36c

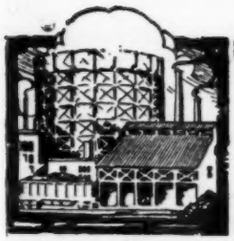
April 1 has come and gone and the soft coal market is rapidly getting no better. For weeks the consumer has been awaiting the coming of that fateful day—"to see what would happen" before making a move in the coal market. Not much happened and he hasn't done a great deal about it. Industrial clouds continue to disappear from the horizon as one by one district settlements are signed, northern West Virginia and central Pennsylvania, which came in last week, having been followed by the Monongahela district, which also signed up for three years. Agreements in Kanawha and western Kentucky have been deferred and there has been a complete suspension in the Southwestern fields and in Alberta.

While these successive adjustments of wages and working conditions are hailed in many quarters as an assurance of industrial peace, the consumer interprets them as removing the incentive to buy coal and seems to have decided to play the waiting game to the limit. Even the contract business usually in evidence at this time is far behind the seasonal level. Mines continue to close on account of scarcity of orders in eastern Ohio, there being no inquiry as yet on lake business.

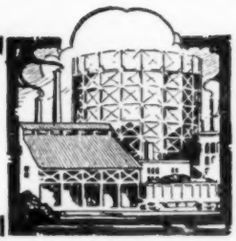
Gas oil is a quiet factor. A better inquiry was reported, but the actual demand was light, and price shading is said to be the rule rather than the exception, particularly on export business.

The sulphate of ammonia market is very dull, with no export trade and a very slight domestic demand.

Demand for anhydrous ammonia is increasing, as the season is opening up.



NEWS OF THE GAS INDUSTRY



Eastern States Gas Conference, Penna. and New Jersey Gas Associations Hold Joint Meeting

The Eastern States Gas Conference and the Pennsylvania and New Jersey gas associations held a meeting at the Bellevue-Stratford Hotel, Philadelphia, Pa., April 9 and 10. There is one thing sure, these associations will have to select hotels with accommodations for hundreds, judging from the attendance at this meeting. Over 500 attended the first day and nearly 1,000 the second day.

Mr. P. H. Gadsden, president of the Eastern States Gas Conference, presided. The Rev. Thomas W. Davis, representing the Mayor of Philadelphia, welcomed the men and gave them the freedom of the city, but he warned them to use this privilege judiciously, as Philadelphia has a major of the U. S. Marine Corps as the Commissioner of Public Safety, which includes the Police Department.

Mr. Gadsden, in his address, pointed out many things which the gas industry could adopt to their betterment. His address follows:

"Service rather than rates is the phase of the public utility question which should be emphasized at this time. In the current discussions of the subject too much stress has been laid upon the rates charged and too little upon the service rendered.

"The popular conception of public utilities is that their rates are generally too high and should be constantly reduced—this in spite of the fact that the price of groceries, clothing, shoes and the rental of houses may be at the time steadily increasing. The average man or woman apparently sees no relation between public utility rates and the cost of the service. In the popular mind there is no appreciation of the intimate relation which exists between rates and service. In every other line of business, in every other field of human activity, it is readily recognized that the better the quality, the higher the price. That in the purchase of a suit of clothes, or an automobile, in the renting of a house or in the buying of groceries, if we select an article of lower price we reluctantly make up our minds to be satisfied with something which is not quite so good. This is the unvarying law of economics which has universal application. It is as potential in the field of public utilities as it is in commerce. The failure to recognize this fact has brought about the partial breakdown of the credit of many steam railroads and has seriously impaired the credit and financial standing of some of the gas companies and other public utilities throughout the country. The public has so long been accustomed to the very high class of service being rendered by its public utilities that it has come to take good service for granted,—it has acted on the assumption that no matter what change may be made in a street railway, telephone, gas or electric rate, the service will remain the same.

"A moment's consideration will show how erroneous this is. It is as true in the public utility business as in mercantile transactions that the quality of the service or of the goods depends mainly upon the price you are willing to pay. Rates in the field of public utilities have the same relation to service as price in the commercial world has to quality. For many years prior to the war the public enjoyed such excellent service from its steam railroads, electric railways, gas and electric light and power companies, that it has lost sight of the fundamental economic relationship of rates to service. Experience during and since the war has emphasized more and more the element of service; and has brought home in the most convincing way that, after all, it is service the public wants and must have—good, dependable, adequate, continuous service, and that the public must in its own interest see to it that these public servants are given such rates as are necessary to provide the kind and quality of service demanded of them.

"The confusion of thought on this subject is further illustrated by the fact that a comparison of rates charged in other cities is frequently resorted to as a basis for a demand for reductions without any consideration having been given to the quality of service which is being rendered elsewhere. It frequently happens that a city which enjoys a lower rate has a poorer service than one with a higher rate, which again illustrates the thought that we get in this world just about what we are willing to pay for.

"What did it mean to New England at a time when business was prospering and traffic on the railroads of the country was establishing new and encouraging records, that embargoes had to be placed against freight moving into New England because of the inability of the New England railroads to handle it?

"What does it mean to a community when its gas company is financially unable to extend its gas mains into new and thriving industrial sections of the city because the rates which it has been allowed to charge are not sufficiently remunerative to attract new capital into the business?

"What does it mean to the future of a city that its electric light and power company has been unable to keep ahead of the progress and development of the community it serves and is unable to furnish electric power necessary for the

establishment of large industrial plants seeking to locate in its midst?

"Why it means that a short-sighted or mistaken policy in dealing with these public utilities—the failure to realize that, after all, service is the essential element, has retarded the development of these communities and has jeopardized their future. This throws into bold relief the fact that the future of the country and of its separate communities is inseparably connected with that of the public utilities which serve them —that a community can grow no faster than its public utilities.

"Looked at from this angle, we see very clearly that, while it is necessary that a community should see to it that the rates charged by public utilities are at all times reasonable, the important thing is that the service upon which the community's life depends shall always be maintained in a high state of efficiency. The loss to the community from poor or inadequate service is much greater than the loss to the stockholder through rates which are too low. The stockholder's interest in a particular public utility is necessarily a limited one, whereas the convenience, comfort and the business life of a city and its future growth and development are wholly dependent upon efficient, reliable and adequate service from its public utilities.

"The conclusion which is inevitably forced upon us, therefore, is that the interests of a community and the utilities which serve it are mutual and dependent one upon another; that the future development and prosperity of every city depend in large measure not only upon the financial strength and business management of its public utilities, but upon the enterprise, courage and vision of those who direct their policies. What a tremendous responsibility, therefore, rests upon the officers of every public utility, not only to see that the present needs of their communities are properly taken care of, but also to look ahead—to visualize the growth and development of the communities for years to come, and to take steps to anticipate such development by the necessary enlargements and additions to their plants, so that the prosperity of the public served shall not be retarded or hampered by lack of the necessary public utility service.

"More important still—what a great responsibility rests upon the stockholders of public utility companies to place in charge of these great properties, having such a tremendous influence upon the comfort, convenience and happiness of the communities in which they operate, men of unquestioned integrity, men of high courage, men who have unfaltering faith in the communities in which they live, and who have the vision adequately to plan for their future development.

"On the other hand, what an equally serious responsibility rests upon the officials of our municipalities, and to a lesser degree upon each individual citizen, to protect these public utilities from unreasonable and unwarranted attacks from those who do not appreciate this mutuality of interest, but are intent merely upon some immediate advantage, and to see that the financial standing of these properties is not weakened and that their ability to serve the present and future interests of the city is not impaired."

L. R. Dutton, secretary-treasurer, read his report, which showed the Conference in a healthy financial condition.

G. I. Vincent, of the Syracuse Lighting Company, Syracuse, N. Y., read a paper, "This Matter of Public Relations." Mr. Vincent's paper told in detail the plan in effect in Syracuse, which has been very successful. This paper will be printed in full in a near issue of the Journal.

The next paper was on "Customer Billing Methods," read by N. U. Porter, United Gas Improvement Company, Philadelphia, Pa.

On Thursday the first paper read was by W. J. Murdock, Coal Products Manufacturing Company, Joliet, Ill., entitled "Use of Bituminous Coal for Generator Fuel." This was a very timely article and will be found in full elsewhere in this issue.

Other papers, all of which were well received, were one by Jacob B. Jones, Bridgeton, N. J., entitled "Employees' Relations with the Gas Company," one by J. Calhoun Smith, Reading Pa., on "Range and Water Heater Replacements," another by Frank L. Blanchard, Henry L. Doherty & Co., New York, "Service Satisfactory to Customers."

At the meeting of the Pennsylvania Gas Association the following officers were elected: President, John A. Frick, Allentown, Pa.; vice-president, Wallace G. Murfit, Newton, Pa.; second vice-president, R. C. Cornish, Philadelphia, Pa.; secretary-treasurer, G. L. Cullen, Harrisburg, Pa. Council members elected: H. A. Gauser, Norristown, Pa.; John A. Weiser, York, Pa.; A. A. Whitlock, Berwick, Pa.; Joseph Jeffrey, Scranton, Pa. There were 119 new active members elected, two gas company members and ten associate members.

At the annual meeting of the New Jersey Gas Association the following officers were elected: President, Raymond Lee, Millville, N. J.; vice-president, H. D. Whitcomb, Newark, N. J.; secretary-treasurer, R. A. Koehler, Newark, N. J.

During the year 1923 over 500 new members were elected, making a total of 664. The slogan adopted is "1,000 members by December 31, 1924."

The banquet was held Thursday night.

The city of Danville gas department, Danville, Va., has placed order with the Gas Machinery Company of Cleveland, O., for bench refillings for two of their benches of sixes. The work includes complete refillings from the ash pan up, using sectional silica retorts and settings.

Gas Co. Urges Economical Use of Gas

Pueblo, Col.—A recent report of the Committee of Home Economics estimates that approximately $2,700,000 in gas is wasted by the 9,000,000 homes using gas in this country each month. The report is based on the assumption that ap-

proximately 10 per cent of the gas consumed in the homes of the country could be saved by more economical use. This waste occurs in spite of the fact that practically every gas company is constantly instructing its patrons on how to save gas.

Half the food cooked in the United States each year is cooked with gas and takes a goodly share of the 1,000,000,000 cubic feet of gas that is produced in the country daily. At the present rate of increase in the use of gas in domestic and industrial fields it is estimated that by 1930 more than 90 per cent of the total production will be used for cooking, heating and industrially, with less than 10 per cent for lighting.

R. T. Hildenbrand, department manager of the Pueblo Gas & Fuel Company, states that every effort is made by the local company to prevent its customers wasting gas. This is borne out by the following ten rules for saving, which are furnished all gas customers:

1. Plan your meals so that the oven will not be burning to cook only one food. The same amount of gas will serve an ovenful.
2. See that all burners are tightly closed when not in use. Escaping gas costs as much as gas that is being burned.
3. Light your match before you turn on the burner and save the gas that would escape while you strike the match.
4. Use the simmer whenever possible. The simmer burner furnishes enough heat to keep any ordinary pan or kettle warm.
5. Turn the air adjustment device so that a blue flame is produced.
6. Use a burner of a size that will not permit the flames to lick around the edges of your pots and pans.
7. See that your burners are not more than one to one and a half inches below the bottom of the pan.
8. Be sure that burners are clean and jets kept open.
9. When food has begun to cook turn down the flame or remove the pot or pan to the simmering burner.
10. Be sure that your oven is air tight and whenever possible bake at a low temperature.

New Rates of Monroe Gas Light & Fuel Company

Lansing, Mich.—An order issued by the State Public Utilities Commission has set the following schedule of rates for the Monroe Gas Light & Fuel Company:

For the first 10,000 cubic feet of gas consumed a month, $1.62 per 1,000; for the next 10,000, $1.57; for the net 10,000, $1.47; for the next 10,000, $1.37; for the next 10,000, $1.27, and for all in excess of 50,000, $1.17. A discount of 10 per cent is allowed when bills are paid within ten days and a minimum monthly charge of 75 cents is authorized.

These rates are a reduction from the temporary rates fixed in February, 1922, but an increase over the rates in the order issued in April, 1923, which never went into effect because it was tied up in the courts.

The commission gave the utility a final book value, including $3,000 for its going value, of $350,000. It is upon this valuation that the new rates are based.

Adirondack Power & Light Co. Gets New Gas Rates

Albany, N. Y.—The Adirondack Power & Light Company, in Schenectady and near by, put into effect on April 1 certain changes in its rates for gas, approved by the Public Service Commission, whereby there will be reductions in all the rates for amounts over 1,000 cubic feet used a month. The present rate per thousand, for the first 50,000 cubic feet, is $1.40 a thousand, less a discount of 10 per cent.

The new rates will be, less a discount of 10 per cent on each thousand cubic feet, $1.40 per thousand for the first 1,000 cubic feet; $1.35 for the next 4,000 cubic feet; with a descending rate for larger consumption, so that where over 100,000 cubic feet are used a month, the rate will be $1, with the 10 per cent discount.

Artificial Gas Supplants the Natural Product

Conneaut, O.—Officials of the North Eastern Oil and Gas Company anticipate an adequate supply of gas, sufficient to cover the needs of this city and vicinity.

At the present time there is not enough natural gas to supply Ashtabula and the rest of the cities and towns in the county, but when the artificial gas from the Diamond Alkali plant at Fairport is turned into the mains at Ashtabula the natural gas supply will be shut off from that city and will leave all of the available supply for the rest of the county.

Contracts Awarded

The constant growth of the population of Pleasantville, N. J., is making it imperative that the Pleasantville Gas Company increase the manufacturing capacity of its plant.

They have, therefore, awarded contract to the U. G. I. Contracting Company, Philadelphia, for the installation of additional carburetted water gas apparatus and other equipment, so that the plant capacity will be increased over 800,000 cu. ft. per day.

Among the recent contracts received by the U. G. I. Contracting Company, Philadelphia, is one covering the installation of a 6 ft. cone top carburetted water gas apparatus for the plant at Marshalltown, Ia. This contract was awarded by the Iowa Railway & Light Company, which controls this property.

Alpena Gas Co. to Double Plant Capacity

Alpena, Mich. — Improvements totaling $35,000 have been planned by the Alpena Gas Company for its local plant, according to an announcement made recently by C. L. C. Kah, local manager.

The first bit of new equipment to arrive under the proposed program will be a water gas set which will more than double the capacity of the plant, now limited to 185,000 cubic feet of gas per day.

This doubling of the capacity of the plant will provide ample gas for heating purposes, toward which business the company intends to direct its efforts.

The next important improvement planned by the company is the installation of five miles of new mains, making it possible for all persons in the reasonably settled districts to use gas.

President Reeside of Washington Gas Light Co. Resigns

Washington, D. C.—Howard S. Reeside, former president of the Washington Gas Light Company, resigned from the board of directors of the company recently because of ill health and will be succeeded on the board by William King, a coal merchant and former president of the Farmers and Mechanics bank.

Ord Preston succeeded Mr. Reeside as president of the gas company at the annual meeting several weeks ago.

Nine-Mile Gas Pipe Line Planned

The Eastern Connecticut Power Company, of which the Putnam Light and Power Company, Putnam, Conn., is a subsidiary, is planning a nine-mile gas pipe line for the transportation of illuminating and fuel gas in Putnam and Danielson and those townships between these two places. The large gas holder, which was completed at Putnam last summer, makes it possible to manufacture and hold in storage enough gas to supply the community.

Gas Co. Increases Capital Stock

The Blackstone Valley Gas and Electric Company, Pawtucket, R. I., will increase its capital stock from $8,000,000 to $16,000,000 for improvements and extensions in power plants and system.

Contracts Awarded

The Interstate Public Service Company of Indianapolis, Ind., has contracted for the installation of a new gas holder for their plant at Aurora, Ind. Contract for this holder has been placed with the Western Gas Construction Company of Fort Wayne, Ind.

The Citizen's Gas & Fuel Company of Terre Haute, Ind., has placed a contract for furnishing a new water gas set, automatic control, Western safety block. The contract for this work has been placed with the Western Gas Construction Company.

The Illinois Power & Light Corporation, of Staunton, Ill., has placed its order for a 6-foot blue water gas set and purifiers with the Western Gas Construction Company of Fort Wayne, Ind., for erection at its plant at Saunton, Ind.

Determination of Horsepower in Bulletin on Utilization of Waste Heat

In Bulletin No. 6, recently issued by the Wickes Boiler Co., Saginaw, Mich., devoted to "The Utilization of Waste Heat for Steam Generation," the following calculation is given to determine the horsepower:

The horsepower which may be developed from waste gases discharging from industrial furnaces may easily be determined from the following simple formula:

$$(1)\quad \frac{W \times S(T-t) \times E}{U \times L} = \text{Horsepower}$$

W=Weight of gas available, pounds per hour.

To accurately determine the gas weight the following information is necessary:

1st—Weight of the coal or oil burned per hour.

2nd—The heat value of the fuel burned.

3rd—The pounds of coke in the ash.

4th—The pounds of carbon in the material handled in the industrial furnace.

5th—The carbon remaining in the product used in the industrial furnace.

6th—A true average gas analysis taken at the entrance to the boiler.

E=Efficiency of the boiler. A constant used to cover radiation, temperature reduction due to air leakage and other losses unaccounted for in the terms of the formula.

T=Initial temperature of the gases.

t=Release temperature of the gases.

U=Unit of evaporation from and at 212 deg. Fahr. per boiler horsepower.

L=Latent heat of vaporization at 212 deg. Fahr.

S=Specific heat of the gases.

The specific heat varies at different temperatures and under different compositions of the gases. The following is the specific heat of some of the principal gases found in this practice:

CO_2	= .217	N	=.244
Air	= .237	CO	=.248
H_2O	= .480	O	=.2175
H	=3.405	CH_4	=.593
C_2H_4	= .369	SO_2	=.155

It may, therefore, be noted that the presence of any very appreciable amount of hydrogen or steam would increase the specific heat considerably. It is, however, usual in a practical consideration of these problems to use for "S" .24 to .30 since most of the gas is nitrogen.

Several sectional illustrations and charts and formula are included. Copy of the bulletin may be had on request.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF AMERICAN GAS JOURNAL.

Published weekly at New York, N. Y., for April 1, 1924.

State of New York, County of New York, ss.: Before me, a notary public in and for the State and county aforesaid, personally appeared Stanton G. Krake, who, having been duly sworn according to law, deposes and says that he is Business Manager of the American Gas Journal, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Name of Publisher—American Gas Light Journal, Inc., 53 Park Place, New York, N. Y. Editor—Ismar Ginsberg, Far Rockaway, N. Y. Managing Editor—Stanton G. Krake, 319 Washington Avenue, Brooklyn, N. Y. Business Manager—Stanton G. Krake, 319 Washington Avenue, Brooklyn, N. Y.

2. That the owners are: American Gas Light Journal, Inc., 53 Park Place, New York, N. Y.; Elbert P. Callender, Morristown, N. J.; Stanton G. Krake, 319 Washington Avenue, Brooklyn, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and security in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

AMERICAN GAS LIGHT JOURNAL, INC.
Publisher.

S. G. Krake, Pres.

Sworn to and subscribed before me this 31st day of March, 1924.

ADELAIDE DE LOCA.

(Seal)

(My commission expires March 30, 1925.)